US ARMY CORPS
OF ENGINEERS
New England District

Contract No. DACW33-01-D-0004
Delivery Order No. 02
September 2002

Final Report

Results of Literature Search and Data Gaps Assessment

RHODE ISLAND REGION LONG-TERM DREDGE MATERIAL DISPOSAL SITE EVALUATION PROJECT

Final Report

Results of Literature Search and Data Gaps Assessment

Task 8 Literature Review
Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project

Contract Number DACW33-01-D-0004
Delivery Order 0002

to

U.S. Army Corps of Engineers
North Atlantic Division
New England District
696 Virginia Rd.
Concord, MA 01742-2751

September 20, 2002

Battelle
397 Washington Street
Duxbury, MA 02332
(781) 934-0571

CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The New England District of the Corps of Engineers (the Corps) contracted Battelle to perform a literature search and data gap evaluation (Task 8) in support of the Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project. This project is evaluating the marine environment offshore of Rhode Island and southern Massachusetts (Figure 1) to determine the suitability of locating an open water dredged material disposal site based on past projections of a potential disposal site. The evaluation focused on twelve major aspects of this offshore environment:

1. Historic Disposal Activities
2. Physical Oceanographic Data and Investigations
3. Sediment Data and Investigations
4. Water Quality Data and Investigations
5. Fisheries/Shellfisheries Data and Investigations
6. Benthic (macro-invertebrate) Resources Data and Investigations
7. Physical Impacts of Fishing Activities
8. Fishing Activities and Human Health Risks
9. Information on Marine Wildlife and Endangered Species
10. Public Parklands, Beaches, and Sanctuaries
11. Historic, Cultural, and Archaeological Resources
12. State Dredged Material Disposal Guidance

An early step in the decision-making process is to acquire pertinent literature, evaluate the extent of understanding of the potentially affected environment, identify gaps in the understanding, and recommend further study to fill the gaps. This report describes the conduct of the literature search, the evaluation completed to date, and a preliminary identification of data gaps. Once the zone of siting feasibility (ZSF) is determined, subsequent literature searches and data gap assessments will focus on the geographic area defined by the ZSF.

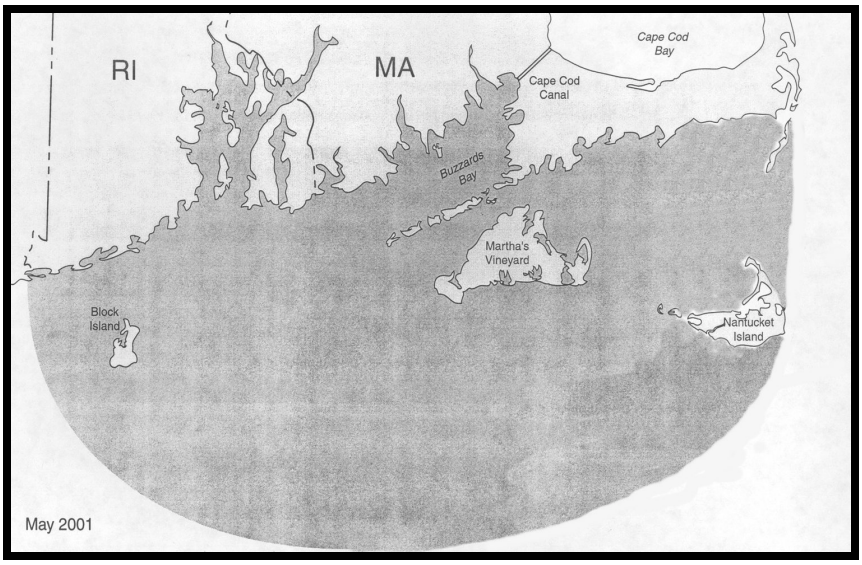

Figure 1. Area Considered During the Literature Search and Data Gap Analysis.

APPROACH

The search and evaluation of references pertinent to the Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project was conducted using a systematic approach. The geographical boundaries of the study area were defined (Table 1) as the offshore areas extending from Block Island to the west and Chatham, Massachusetts to the east. The search began by collecting references published beginning in 1980 and continuing through the present. However, the search was extended to earlier years in some of the aspect areas listed as some references older than 1980 were still relevant. Specific search terms or key words were used to query electronic literature databases. Reference lists ranging from tens to hundreds of references were produced for the various combinations of search terms. These lists, with references consisting of a citation and, in some cases an abstract, were reviewed by appropriate knowledgeable staff, to determine which references should be acquired via interlibrary loan requests. References identified by this process were screened for relevance to the Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project, categorized, and entered into a project-specific ProCite literature database. In addition, some scientists were directly contacted to determine whether they possessed any unpublished data from the region. The Corps and Battelle agreed to a 500-reference limit for review during this initial compilation. Below is a detailed description of each phase of the literature search.

Applicable Water Body and Key Word Determination

Before beginning the electronic literature search, key words and search constraints were determined during discussions between the Corps, EPA Region 1, and Battelle. Many words and phrases found in the Long Island Sound Disposal Site Study literature search database (ENSR 1999) were incorporated into the list of key words used by the Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project search. A key word list and literature database from the Providence River and Harbor Maintenance Dredging Project Final Environmental Impact Statement (PRHMDP EIS) (USACE 2001) literature search were not available.

The geographic area was limited to Block Island Sound, Narragansett Bay, Rhode Island Sound, Buzzards Bay, Vineyard Sound, and Nantucket Sound. Key words were identified based on the topic areas identified in Table 1 and the search terms used during the Long Island Sound Disposal Site Study.

Initial Electronic and Hardcopy Literature Searches

The initial electronic searches used the key words in Table 1 and the geographic area (described above) as criteria for identifying published information available through interlibrary loans. Various references were accessed, including peer-reviewed publications (e.g., books, professional journals), newspaper and magazine articles, masters theses and doctoral dissertations, among others. Direct computerized searches were conducted of the reference libraries at Woods Hole Oceanographic Institute (WHOI), Marine Biological Laboratory (MBL) associated with Boston University, University of Massachusetts in Dartmouth, MA, and University of Rhode Island (URI) libraries by using the same key words and geographic areas.

Initial searches for pertinent references also included a review of the PRHMDP EIS list of references, and a Buzzards Bay Bibliography List developed by Dr. Bruce Tripp at WHOI. Several relevant references were identified from these two lists.

Table 1. Key Words Used for the Initial Literature Searches.

Topic Area	Key Words
Coastal Management	Land Use, Shoreline, Erosion and Sedimentation
Ecology, Habitats and Species	Birds, Foraminiferal, Vegetation, Species Inventory, Marshes, Algae, Submerged Aquatic Vegetation, Other Habitats
Economic Data and Analysis	Commercial Fishing, Ferries, Commercial Recreation, Recreational Boating, Commercial Cargo, All (Economic Data and Analysis)
Environmental Evaluation and Economics of Disposal Options	Alternative Sites-Cost, Testing and Evaluation-Cost, Alternative Methods-Environmental, Alternative Sites-Environmental, Alternative Methods-Cost, Testing and Evaluation-Environmental, All (Environmental and Economics)
Fisheries/Shell Fisheries	Aquaculture/Commercial Area, Mussels, Plankton (Fisheries), Oysters, Spawning, Migration, Essential Fisheries Habitats, Economic Value (Catch per Effort), Recreational Uses, Lobster, Nursery All (Fisheries/Shell Fisheries)
Fishing Activities and Human Health Risks	Contaminants, Health Advisories, Nuisance and Toxic Phytoplankton Blooms, Toxicity Testing, All (Fishing Activities and Human Health)
General Interest	Management and Policies, Pollution
Geology and Geomorphology	Hydrogeology, Geochemistry, Seismic Profiles, History, All (Geology)
Historic Disposal Activities and Dump Sites	Volumes and Types of Material, Physical Effects, Chemical Effects, Biological Effects, All (Historic Disposal Activities)
Historic, Cultural and Archaeological Resources	Native American Tribal Interest/Resources, State Significant, Federally Significant, Eligible for Listing All (Historic, Cultural and Archeological)
Marine Wildlife and Endangered Species	Habitat, State Status, Federal Status, All (Marine Wildlife)
Physical Impact of Fishing Activities	Dragging Effect on Mound, Impact on Recolonization, All (Physical Impact of Fishing)
Physical Oceanographic	Waves and Wind Fetch, Salinity, Tides, Temperature, Hydrography, Circulation, Currents, Sediment Transport, All (Physical Oceanographic)
Public Parklands, Beaches and Sanctuaries	Sanctuaries, Public Beaches, State Parks, Other, All (Public Parklands)
Sediment	Sediment Chemistry, Bottom Morphology, Physical Characteristics, All (Sediment)
State Dredged Material Disposal Guidance	Rhode Island, Connecticut, New York, All (State Guidance)
Water Quality	Plankton (Water Quality), Nutrients, Thermal Pollution, Metals, Organics, Pesticides, PCBs, Dissolved Oxygen, Bacteria/Pathogens, Suspended Solids, Phytoplankton, Zooplankton, Ichthyoplankton, Other Toxics, All (Water Quality)
Geographic Areas	Block Island Sound, Rhode Island Sound, Narragansett Bay, Buzzards Bay, Vineyard Sound, Nantucket Sound
Publication Dates	1980 to present

Extended Electronic Literature Search

The initial searches did not yield information on several of the topic areas, most notably benthic communities, sediments, and endangered species. Upon further consultation with senior technical staff, the geographic area was expanded to include the northwestern Atlantic region and, in some instances, less specific search terms than those listed in Table 1. These additional searches successfully located other references. After completing this second series of searches, data gaps for some topic areas were still apparent. Based on experience with electronic searches, it was determined that additional broader electronic searches would not likely be productive.

Direct Contact with Federal and State Agencies and Universities

In addition to computerized literature searches, scientists at several Federal and State agencies and universities were contacted directly to identify and collect relevant unpublished literature. Table 2 lists scientists contacted during the literature search.

Battelle initially contacted most of these scientists by phone with follow-up e-mails or letters formally requesting any pertinent information. Battelle also spoke directly with several scientists during an EPA-sponsored workshop for the Long Island Sound National Estuary Program conducted at the University of Connecticut (UCONN) Avery Point Campus. Battelle discussed possible relevant information with scientists from the University of Connecticut (UCONN), the URI, and Federal agencies (EPA Region 1, National Marine Fisheries Service (NMFS), U.S. Geological Survey (USGS)). Most responses indicated that any pertinent information would be found at WHOI, MBL, NMFS in Woods Hole, or URI.

Table 2. Organizations and Persons Contacted Directly During the Literature Search.

Affiliation	Name
Coastal Vision	Drew Carey
Massachusetts Division of Fish and Wildlife	Bruce Estrella Phil Brady Tim Currier
Narragansett Bay National Estuary Program and National Estuarine Research Reserve	Chris Deacutis
NMFS	Mike Ludwig
Rhode Island Department of Fish and Wildlife	Arthur Ganz Chris Powell Tim Lynch Tom Angell
USGS	Ellen Mecray
URI	Candace Oviatt Dave Butel
EPA Region 1	Gerry Pesch John Paul
UCONN	Frank Bohlen Dan Codiga
WHOI	Bruce Tripp

Site Visits

Battelle staff traveled to several local university and agency libraries to collect references available for use only at the library (e.g., doctoral dissertations, reference books). These site visits included reference libraries at the URI's Main Campus (Kingston, Rhode Island) and Pell Campus (Narragansett, Rhode Island), WHOI, MBL, and NMFS. Citations and references were also collected from the Corps when available.

Literature Retrieval and Review

A comprehensive list of references was compiled into a ProCite© database as a result of the literature search and site visits. Efforts were made to ensure that references were not duplicated within the database by comparing the names of authors and titles as an initial review. Those articles with titles close in wording were visually compared to determine whether they were the same or different. Sources of each reference were then identified and contacted to request copies either through interlibrary loan or as a photocopy. Initial acquisition of the hardcopies was delayed significantly by incomplete or inaccurate citations and problems with loan requests. Efforts to resolve these inconsistencies resulted in the collection of the majority of citations.

During review of the references collected, additional references that may be pertinent to the study were identified resulting in identification of more references than the 500-reference limit for review. These additional references were added to the ProCite© database, but are not incorporated into this summary report or the data gap analysis. Citations for articles that have not been located due to incomplete or inaccurate citations will also remain in the ProCite© database in the hopes that they will be located at a later date. Several additional references identified by the Corps and EPA staff during review of the draft version of this report have been included in the reference list. However, these reports have not yet been collected.

LITERATURE IDENTIFIED

The literature search identified over 600 references judged to be relevant to the study based on titles, keywords, and abstracts (when available). The citation for each source was entered into a ProCite© Database. Available abstracts were also incorporated into the database. Appendix A is a printout of references in the ProCite© Database, including available abstracts.

Approximately 500 references were obtained and assessed for relevancy to the study (Table 3) based on the following Corps requested categories:

1) Relevant with data (Category 1) – the reference includes data relevant to the topic area and a region. The data should be helpful in drafting the EIS and supporting documents.

2) Relevant with no data (Category 2) – the reference is relevant to the topic area and a region, but is not a primary data reference.

3) Not relevant (Category 3) – the reference is not relevant to the study.

The number of references identified under each of the 12 major topic areas are summarized by data relevancy (Table 3), by region (Table 4), and Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) disposal site siting criteria (Table 5). Appendix B lists all of the articles collected during the literature search, sorted by topic area. The list in Appendix B includes information on the relevancy of the reference (i.e., Category 1, 2, or 3 as assessed), the topic and region where the reference was determined to be pertinent, and if the reference would be useful in determining compliance with MPRSA specific and general criteria for dredged material site designation.

Table 3. Topic Area Summary by Relevancy to the Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project.

Topic	Number of References				
	Total Identified During the Literature Search	Total Reviewed for Data Gap Analysis	Category 1 Relevant with Data	Category 2 Relevant without Data	Category 3 Not Relevant
A. Historic Disposal Activities	24	22	14	7	1
B. Physical Oceanographic Data and Investigations	62	52	22	20	10
C. Sediment Data and Investigations	81	71	19	22	30
D. Water Quality Data and Investigations	22	20	6	7	7
E. Fisheries/Shellfisheries Data and Investigations	257	212	52	85	75
F. Benthic (Macro-Invertebrate) Resources Data and Investigations	67	58	10	26	22
G. Physical Impacts of Fishing Activities	7	6	1	2	3
H. Fishing Activities and Human Health Risks	0	0	0	0	0
I. Information on Marine Wildlife and Endangered Species	32	32	2	27	3
J. Public Parklands, Beaches, and Sanctuaries	5	5	0	5	0
K. Historic, Cultural and Archaeological Resources	7	7	4	2	1
L. State Dredged Material Disposal Guidance	3	3	2	1	0
Unclassified	47	16	0	3	13
Total	614	504	131	207	165

Note – Some literature is applicable to several different topics but has only been counted once under the area where it is most significant.

Table 4. Topic Area Summary by Region of Reviewed References.

Topic	Number of References					
	Block Island Sound	Narra-gansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound
A. Historic Disposal Activities	1	6	9	6	4	3
B. Physical Oceanographic Data and Investigations	24	12	11	9	9	5
C. Sediment Data and Investigations	15	29	8	6	5	2
D. Water Quality Data and Investigations	3	13	2	6	1	0
E. Fisheries/ Shellfisheries Data and Investigations	21	68	32	37	14	18
F. Benthic (Macro-Invertebrate) Resources Data and Investigations	4	12	4	17	4	13
G. Physical Impacts of Fishing Activities	0	2	1	2	1	0
H. Fishing Activities and Human Health Risks	0	0	0	0	0	0
I. Information on Marine Wildlife and Endangered Species	5	3	6	4	8	25
J. Public Parklands, Beaches, and Sanctuaries	0	0	0	1	0	0
K. Historic, Cultural and Archaeological Resources	2	2	3	5	4	6
L. State Dredged Material Disposal Guidance	0	0	1	2	1	1
Unclassified	4	2	2	1	1	2
Total	79	149	79	96	52	75

Table 5. Region, Type of Study, and Relevant MPRSA Criteria Summary of Reviewed Articles.

	Number of References			
	Relevant with Data (1)	**Relevant without Data (2)**	**Not Relevant (3)**	**Total Reviewed**
Region				
Block Island Sound	29	81	21	130
Narragansett Bay	46	146	38	229
Rhode Island Sound	39	94	10	142
Buzzards Bay	41	97	27	163
Vineyard Sound	19	48	13	78
Nantucket Sound	26	89	5	118
Type of Study:				
Environmental Analysis	15	38	7	60
Field Sampling	59	174	48	281
Lab Analysis/Tests	8	39	23	70
Model	3	20	6	29
Monitoring	26	63	5	94
Baseline Characterization	32	98	19	149
Impacts Analysis	9	36	9	54
Historical	23	56	15	94
MPRSA CRITERIA				
40 CFR Sec. 228.5 – General Criteria				
a) Minimize interference w/other activities, avoiding existing fisheries or shellfisheries, regions of heavy commercial or recreational navigation.	29	69	2	100
b) Initial mixing from disposal can be expected to be reduced to normal ambient seawater levels or undetectable contaminant concentrations before reaching any beach, shoreline, marine sanctuary, of known geologically limited fishery or shellfishery.	7	16	0	23
c) If any existing interim sites are found not to meet criteria (sec. 228.5 – 228.6), use will be terminated as soon as alternate site can be designated.	0	0	0	0
d) Size of disposal sites will be limited to allow for effective monitoring and surveillance programs to prevent adverse long-range impacts.	1	2	0	3
e) USEPA will, wherever feasible, designate ocean dumping sites beyond continental shelf and other such sites that have been historically used.	4	4	0	8
40 CFR Sec. 228.6(a) – Specific Criteria				
1. Geographic position, depth of water, bottom topography and distance from shore.	13	24	3	40

Table 5. Region, Type of Study, and Relevant MPRSA Criteria Summary of Reviewed Articles (Continued).

	Number of References			
	Relevant with Data (1)	**Relevant without Data (2)**	**Not Relevant (3)**	**Total Received**
2. Location relative to breeding, spawning, nursery, feeding or passage areas of living resources in adult or juvenile phases.	31	104	8	143
3. Location relative to beaches or other amenity areas.	2	4	0	6
4. Types and quantities of wastes proposed to be disposed of, proposed methods of release, includes methods of packing waste, if any.	1	3	1	5
5. Feasibility of surveillance and monitoring.	0	0	1	1
6. Dispersal, horizontal transport and vertical mixing characteristics of area, includes prevailing current direction and velocity, if any.	12	22	1	35
7. Existence and effects of current and previous discharges and dumping in area (includes cumulative effects).	11	16	1	28
8. Interference w/shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance and other legitimate uses of ocean.	13	29	0	42
9. Existing water quality and ecology of site as determined by available data or by trend assessment or baseline surveys.	9	19	0	28
10. Potential for development or recruitment of nuisance species in disposal site.	0	1	0	1
11. Existence at or near site of any significant natural or cultural features of historical importance.	1	2	0	3

DATA GAP ANALYSIS

Screening of the collected references identified the following gaps in the available information characterizing the study area. Italicized sentences are the Corp's requested topics evaluated for data gaps. Unitalicized text is the result of the data gap analyses of the topic.

A. Historic Disposal Activities and Effects on Disposal

Information on past dredged material disposal activities and on the effects of disposal at the disposal sites.

This topic identified information on past dredged material disposal activities and the effects of disposal on the disposal sites. Twenty-seven references published between 1971 and 2001 contain relevant information. Some of the reports described recent conditions at historic, current, or candidate dredged material disposal sites in Rhode Island Sound and Buzzards Bay. Information on the quality and characteristics of past dredged material disposed at these sites were not available in these references. The PRHMDP EIS provides information on the previously used Brenton Reef site (Site 16), two potential disposal locations (Sites 18 and 69a), and the Jamestown Bridge Reef site (Site 69b), designated for disposal of the PRHMDP material. Bathymetry, water column chemistry, sediment resuspension, sediment profile images, sediment chemistry, and benthic macroinvertebrates data from recent reports on the previously used Buzzards Bay and Cleveland Ledge disposal sites were identified. The literature search did not identify other information on historic dredged material disposal activities or quantities of dredged material previously placed at disposal sites in the Rhode Island Sound and southeastern Massachusetts region. Information in the references is not adequate to describe the location of previous disposal sites and disposal activities. Information on the locations of past dredged material disposal operations must be obtained from relevant regulatory agencies (State and Federal) to ensure knowledge on historic disposal sites in Rhode Island Sound, Buzzards Bay, and Vineyard Sound is complete.

Limited information on the effects (either short- or long-term) of previous disposal activity in the study area was found. However, information on the effects of dredged material disposal at other dredged material disposal sites in coastal New England having similar physical characteristics are available through the Disposal Area Monitoring System (DAMOS) program (USACE 2002). These, in concert with other information gathered and evaluated to support this site designation, should provide an adequate basis for assessing potential impacts at prospective alternative sites.

B. Physical Oceanographic Data and Investigations

Studies, modeling efforts and data collected on hydrography, including wind fetch and wind-generated waves, tidal and residual currents, and storm events, and their effect on circulation patterns, sediment transport, and bottom characteristics. Available detailed bathymetry, erosion/deposition data and sediment transport information for historic disposal sites and the currently considered proposed disposal sites [18, 69a, and 69b] and the Rhode Island Sound, Block Island Sound and southeastern Massachusetts waters area as a whole.

Physical oceanographic information identified through this literature search included currents and circulation, waves, bathymetry (topography), and sediment transport. A total of 76 references were identified including current charts for all of the water bodies and wind and wave characterizations in Rhode Island waters. Although a number of the reports are more than 10 years old, major changes in circulation, currents, or current patterns are not expected in the area. Thus, information from these studies in association with the limited current data collected by the Corps in the study area in the summer and fall of 2001 and spring 2002 should provide adequate information to characterize the physical oceanographic conditions in the study area. The wave and current data should also be adequate to support dispersion and fate modeling and sediment transport evaluations.

Detailed, recent bathymetric data of the Buzzards Bay and Cleveland Ledge dredged material disposal sites are available. Similar information on Sites 18, 69a, and 69b in Rhode Island Sound has been gathered under the PRHMDP site designation process. Very little recent physical oceanographic and bathymetric information for Vineyard, Nantucket, or western Block Island Sounds was found in the references. If these candidate areas pass initial screening for the ZSF and other factors such as water depth considerations (i.e., are in nondepressive areas), physical oceanographic and bathymetric surveys may be required to develop data to support the site designation.

C. Sediment Data and Investigations

Information on sediment type, grain size, and chemistry, including side scan data, particularly in formats useful in developing maps of the Rhode Island Sound, Block Island Sound and southeastern Massachusetts waters area.

Approximately 112 references were identified during the search containing information on sediments in the study area. Of the references identified, 27 were published within the past 10 years. The references contained information and data on grain size, bottom type (roughness), and sediment chemistry for localized regions within the study area. However, information sufficient to support sediment characterization of the entire study area was not identified. Some additional information may be available through unpublished USGS and NOAA bathymetry/side scan sonar surveys for the area. During the literature search, attempts were made to locate a published reference or contact name for the USGS and NOAA data, but none were found. Therefore, a reference for these data have not been included on the reference list.

Recent sediment characterization information on local areas in Rhode Island Sound is available from the information collected for the PRHMDP (Sites 18, 69a and 69b). Further data and information have been collected for those same sites and Site 16 under the Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project (Battelle 2002). This report provides adequate data for the four locations studied.

Site-specific sediment characterization and bottom type information was located for Nantucket Sound, Block Island Sound (more so for the eastern extent of the island) and Narragansett Bay. Less comprehensive information was identified for Buzzards Bay, although continuing literature searches and reviews may locate sufficient information on sediment characterization, similar to

the reports prepared by O'Hara and Oldale (1980) that characterize the bottom geology of Vineyard Sound and Eastern Rhode Island Sound.

Recent reliable data on sediment contamination in most of the study area was limited and many of the references identified were more than 15 years old (from the 1970s). Recent chemistry data is available for Narragansett Bay and appears sufficient to characterize that region. However, with the exception of Sites 18, 69a and 69b, no recent information was located for Rhode Island, Block Island, Vineyard or Nantucket Sounds.

Pending review of the reports in preparation and interviews with the USGS and NOAA, the sediment data does not appear to be adequate to characterize broad scale sediment features in the study area. Site-specific data may be adequate if the screening process eliminates many of the areas based on other characteristics (e.g., depth considerations to find sites that are containment areas and avoid sediment erosion and transport).

D. Water Quality Data and Investigations

Investigations and information on water column characterizations, including temperature, salinity, dissolved oxygen, pH, and turbidity, and chemistry data (metals, organics, pesticides, PCBs, other toxics). Measurement and variability of water quality data throughout Rhode Island Sound-, Block Island Sound- and southeastern Massachusetts-waters area, including spatial variability as well as seasonal variability and stratifications.

Fifty references were collected under the literature search for water quality data and investigations. Most of the reports were dated (over 10 years old) and of limited scope, focusing mainly on the Narragansett Bay and Buzzards Bay regions. Relevant water quality characteristics in the open waters of the study area are not expected to have changed much in the past 10 years. Comparisons of data collected in the summer of 2001 with data from Rhode Island Sound collected in the mid 1980's should provide sufficient information to characterize the Rhode Island Sound and Block Island Sound region. Other areas, however, are not well characterized with respect to contaminants. Searching out and evaluating unpublished data for these areas may provide additional information. However, the adequacy of the data to characterize the major sounds and bays in the study area is limited to those with recent measurements (i.e., Sites 16, 18, 69a and 69b in Rhode Island Sound). Additional data may not be required if the ZSF and site screening process eliminates many of the areas from consideration based on other characteristic (e.g., depth, bottom topography, etc).

E. Fisheries/Shellfisheries Data and Investigations

Information on the presence of fish and shellfish including spawning, nursery (larvae) and migration, particularly information based on trawl and similar sampling efforts. Presence and extent of fishing and shellfishing grounds and aquaculture within the Rhode Island Sound-, Block Island Sound- and southeastern Massachusetts-waters area, whether natural or managed, commercial or recreational. Information on the economic value of fisheries and shellfisheries, including catch/effort and locations for lobster and other important commercial fish/shellfish.

Location and evaluation of essential fisheries habitat areas and presence, extent and value (health) of submerged aquatic vegetation.

Fisheries

The literature review identified numerous studies relevant to fish resources in the study area. Thirty-two studies pertaining solely to winter flounder have been collected for areas offshore southern New England, including Rhode Island and Massachusetts. These studies date back to the early 1970s and extend to the present. There appears to be adequate information on movement, life history characteristics and distribution to adequately characterize the winter flounder resource in the study area.

Additional species-specific studies were identified in the literature review, including tautog, striped bass, goosefish, menhaden, silversides, bluefin tuna, bay anchovy, scup, black sea bass and Atlantic cod. The studies for these species evaluate feeding behavior, habitat use, growth and general life history characteristics. Some of the articles are dated, although, for the purposes of describing the life history characteristics for these species, it is anticipated that this information has not changed over the past several years. Published data from offshore, long-term fish monitoring or sampling programs were not located. Unpublished reports and raw data from NMFS trawl surveys or Massachusetts Department of Environmental Management (MDEM) surveys would also be useful in characterizing the fishery resources in the area and for evaluating temporal changes in the fishery resources.

Lobster

Several references pertaining to the lobster resources of the study area were collected during the literature search. Annual reports from both Massachusetts and Rhode Island describing their sampling programs for lobsters are available and will provide adequate information on catch per unit effort for various regions within each state. One region within the study area that may not be well represented, however, is Nantucket Sound. Information on lobster shell disease exists for both states. Several references discuss the general life history characteristics of lobsters in southern New England waters, including postlarval settlement, growth, feeding and migratory behaviors. Very little information was found pertaining to larval distribution of lobsters in offshore waters. The one study that did evaluate larval distributions is somewhat dated. Additional personal communications with Bruce Estella or Stan Cobb (Massachusetts Department of Marine Fisheries) may be helpful in identifying more recent larval information. Although information of lobster fishing at Sites 18, 69a and 69b exists from the PRHMDP, other site-specific habitat use information for juvenile and adult lobsters is lacking. This information may be inferred from the Massachusetts and Rhode Island state lobster sampling reports, including the V-notch program, and species profile information. Side-scan sonar and benthic habitat maps of the study area, combined with catch statistics, will be beneficial in determining habitat use.

Quahogs and Other Bivalves

The comprehensive literature review identified several references pertaining to shellfish resources, including quahogs, in the study area. Narragansett Bay, and to a lesser degree Buzzard's Bay, were well represented in the shellfish and quahog studies. One study specifically described oyster resources in Narragansett Bay. Another report described shellfish distributions

at the four candidate sites developed for the PRHMDP in Rhode Island Sound (Site 16, 18, 69a, and 69b). The remainder of Rhode Island Sound along with Block Island, Vineyard, and Nantucket Sounds were sparsely represented in the shellfish and quahog studies. Moreover, the available information may be dated. If sites are considered in other locations than those listed above, more recent studies would be useful.

F. Benthic (Macro-Invertebrate) Resources Data and Investigations

Information on the presence of benthic resources in Rhode Island Sound, Block Island Sound and southeastern Massachusetts waters area and at historic disposal sites. Recolonization and species assemblages as an indicator of toxicity at historic disposal sites.

The comprehensive literature review identified several references pertaining to benthic resources in the study area. Available benthic studies provide good coverage of Narragansett Bay, Buzzards Bay, and Nantucket Sound and sparse coverage of Rhode Island, Block Island, and Vineyard Sounds. The only benthic community study of Block Island Sound found is dated 1951. More recent studies will be useful if available.

The PRHMDP gives information on three Rhode Island Sound sites (Sites 18, 69a, and 69b). The 2001 toxicological study completed at Site 16 for the present Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project should provide adequate benthic community information on this location. Information on other locations in the study area may be required if sites other than those noted are identified during the site screening process.

G. Physical Impacts of Fishing Activities

Information on the effect of fishing activity on benthic recolonization and fish habitat.

The comprehensive literature review identified few studies describing the impacts of various types of fishing gear on the benthic habitats in the study area. However, one study specific to southern New England evaluated the impact of ghost gill nets on fishery resources in the area and another reference discussed the physical impacts of trawls in Rhode Island Sound based on NOAA side-scan data from the mid-1990's. Efforts should be made to contact the NMFS or state fishery resource divisions to find out if additional information exists. Otherwise, searches of impacts of fishing gear on benthic habitats and recolonization for areas outside the study region may be necessary to address these issues.

H. Fishing Activities and Human Health Risks

Contamination of fish catch, biomagnification of contaminants and consumption patterns, particularly from historic disposal site vicinity. Human health effects of seafood consumption from Rhode Island Sound, Block Island Sound and southeastern Massachusetts water areas. Information on the incidence and location of past blooms of nuisance and toxic phytoplankton species. Information on State health advisories in the Rhode Island Sound, Block Island Sound and southeastern Massachusetts waters area including locations, incidences, contaminants, and species.

The comprehensive literature review did not identify studies in the area that directly pertain to the human health risks associated with consumption of fish tissue containing elevated levels of chemical contaminants. Several of the studies addressed chemical contaminant concentrations in fish tissue, including the Fall 2001 finfish characterization of the present study. Efforts should be made to gather human health risks associated with fish tissue chemical contaminants from regions outside southern New England for comparison.

No information was located on State Health Advisories in the study area.

I. Information on Marine Wildlife and Endangered Species

Information on presence and geographical extent of marine wildlife, Federal and State listed species and critical habitats.

Several references pertaining to marine wildlife and endangered species were identified during the comprehensive literature search. Thirty-five articles were identified that described the movement, life history characteristics, and distribution of marine wildlife and endangered species found in the study area. One source, Appendix L of the PRHMDP, is a Biological Assessment evaluating the disposal of dredged material in Rhode Island Sound. The discussion in Appendix L is considered relevant to most potential sites within Rhode Island or southeastern Massachusetts's waters. If needed, additional published references are available on this subject area as it is widely studied. At the time of EIS preparation, NMFS and Dr. Bob Kenney of URI should be contacted to collect information on the latest observations.

J. Public Parklands, Beaches and Sanctuaries

Provide information on the location of any public parklands, beaches, and sanctuaries in relation to the study area.

The comprehensive literature search did not identify many references on the location of public parklands, beaches, and sanctuaries. The location of most state-managed parklands, beaches, and sanctuaries along the coasts of Rhode Island and southeastern Massachusetts were identified. Information on town/city-operated beaches was not located during the literature search. Recent nautical charts (Maptech 2001) showed that no marine sanctuaries have been designated within Rhode Island and southeastern Massachusetts's coastal waters, and a review of NOAA's website (NOAA 2002) verified that a marine sanctuary is not planned in this area at this time.

The PRHMDP discusses the use of available dredged material disposal sites within Narragansett Bay and Rhode Island Sound and the effects on any local recreational areas that may develop. Any additional sites that may be considered should be assessed for its effects to local beaches and public areas. At that time, information on town/city-operated beaches should be collected for the area around the considered site.

K. Historic, Cultural and Archaeological Resources

Location of known and potential cultural, historic and archaeological resources in the Rhode Island Sound, Block Island Sound and southeastern Massachusetts water areas. Also need to address Native American tribal interests in the Sound region and its resources.

Several references were located pertaining to historic, cultural, and archaeological resources in the Rhode Island and southeastern Massachusetts region. These references date from the 1940's to the present. The most abundant information located was on shipwrecks and other obstacles in the study area. Two separate databases, one run by NOAA and the other by Dr. Warren Riess of the University of Maine's Darling Marine Center were included in the references found. Both databases give information on the names and locations of known shipwrecks. The NOAA database also has information on other underwater obstacles in the area. Features indicating ordnance or military use areas were noted on NOAA charts of the area and will need to be further addressed in the site screening. Information on the possible locations of cultural and archaeological resources, other than shipwrecks, was collected for the three Rhode Island Sound sites (Sites 18, 69a, and 69b) and one Narragansett Bay site (Site 3) considered for dredge material disposal under the PRHMDP (Appendix M of the PRHMDP Final EIS). Based on the information collected, there appears to be adequate information on the location of shipwrecks and other identified obstacles in the study area. The possible existence of other cultural or archaeological resources at sites located in the Rhode Island or southeastern Massachusetts regions, other than those already noted, would need to be assessed on a location-specific basis. Coordination with the State Historic Preservation Officers should also be conducted.

L. State Dredged Material Disposal Guidance

Information and guidance developed by the States to regulate dredged material disposal and disposal site identification, screening, use, monitoring and management.

During the literature search, three references were noted under the topic of Dredged Material Disposal Guidance. One of the identified references reviews the Rhode Island dredging and disposal policies. Another is the Massachusetts Surface Water Quality Standards for the Commonwealth of Massachusetts, which identifies the Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the United States within the Commonwealth (314 CMR 9.00). The remaining identified source is a compilation of local regulations pertaining to water quality in Buzzards Bay.

CONCLUSIONS

The purpose of this literature search was to assess the extent of information available on each of the ecological and regulatory topics defined by the Corps that was relevant to Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project. Identified references (up to 500 total) were evaluated to determine if sufficient data and information currently exists to support the selection of an offshore dredged material disposal site within the study area.

Of the 500 articles reviewed, most focused on ecological issues or are site-specific (*i.e.*, related to PRHMDP). The review found that most of the Narragansett Bay area is well characterized for most of the topic areas. Moreover, adequate information was found to assess the ecological conditions of each of the six candidate dredged material disposal sites identified by previous studies in Rhode Island Sound (Sites 16, 18, 69a, and 69b) and Buzzards Bay (Cleveland Ledge and Buzzards Bay disposal sites). Fisheries and endangered species are adequately characterized throughout Rhode Island Sound. Information on the remaining portions of Rhode Island Sound, Block Island Sound, Nantucket Sound, Vineyard Sound, and offshore areas are adequate to only give a very general ecological characterization of these regions.

At the time this literature review was conducted, all water bodies from Rhode Island Sound to Buzzards Bay to Nantucket Sound were included in the search. The ZSF report was in preparation concurrent with the literature search and review. The findings of the ZSF report will assist greatly in focusing the remaining literature review.

Once the ZSF report has been completed, site screening will identify areas where sites may be located. If locations other than the four candidate sites (16, 18, 69a, and 69b) identified by previous regulatory actions in Rhode Island Sound are chosen, additional ecological characterization data will likely be necessary to support the designation of an offshore dredged-material disposal site.

In addition to data gaps noted for the previously identified candidate disposal areas in Rhode Island Sound (i.e., Sites 16, 18, 69a, and 69b) and the Buzzards Bay sites, the following specific data gaps were noted during the review:

- **Historical Disposal Activities** - Additional information on where dredged–material disposal operations occurred in the past and the types and amounts of material deposited should be obtained from relevant regulatory agencies (State and Federal) to ensure the extent of knowledge on historic disposal sites in Rhode Island Sound, Buzzards Bay, and Vineyard Sound is complete. These gaps may be reevaluated once the dredging needs study is completed (USACE, In preparation).
- **Physical Oceanographic Data and Investigations** – Sufficient information was located on Narragansett Bay and Rhode Island Sound. If areas are considered in Vineyard, Nantucket, or western Block Island Sound, additional information may be necessary.
- **Sediment Data and Investigations** - Information was insufficient regarding the sedimentary regime of the entire study area.
- **Water Quality Data and Investigations** – Water quality data was not located for Rhode Island, Block Island, Vineyard or Nantucket Sounds, with the exception of Rhode Island Sound Sites 18, 69a and 69b.
- **Fisheries/Shellfisheries Data and Investigations** –
    - **Fisheries** - There appears to be a lack of information from the Massachusetts and Rhode Island state agencies regarding offshore (e.g., outside the 3-mile Territorial Sea) long-term fish monitoring or sampling programs.
    - **Lobsters** -Very little information was found describing larval and subadult lobsters in offshore waters. Side-scan sonar and benthic habitat maps of the study

area combined with catch statistics will likely be useful for characterizing habitat use.

  - **Quahogs** – Sufficient information on shellfish populations in Narragansett Bay, Buzzards Bay, and the four Rhode Island Sound dredged material disposal sites considered under the PRHMDP was collected. If other areas are considered for dredged material disposal, more recent information will be needed for each site.

- **Physical Impacts of Fishing Activities** – A search of impacts of fishing gear on benthic habitats for areas outside the study region may be necessary to fully address these issues.
- **Fishing Activities and Human Health Risks** – Insufficient information exists to describe human health risks associated with consuming fish harvested from offshore waters and the potential influence from dredged material disposal.
- **Public Parklands, Beaches, and Sanctuaries** - The locations of State and Federal public parks, beaches, and sanctuaries are well documented. Municipal (local) parks and beaches were not included in the search thus far, but the locations will be included in the continuing search to ensure potential transport from candidate sites can be properly evaluated.
- **Historic, Cultural, and Archaeological Resources** – The possible existence of other cultural or archaeological resources at sites located in the Rhode Island or southeastern Massachusetts regions, other than those locations assessed by other programs (*i.e.*, PRHMDP), would need to be assessed on a location-specific basis. Coordination with the State Historic Preservation Officer will also need to be conducted. Information on the status of areas designated for military activities and any ordnances located in the study area will need to be obtained, if these areas are included in the ZSF.
- **State Dredged Material Disposal Guidance** – If new dredged material disposal guidance is developed by Massachusetts and Rhode Island State agencies and Federal agencies, the documents will be incorporated into the literature database.

REFERENCES

Battelle. 2002. Fall 2001 Sediment Characterization Report for the Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project.

ENSR. 1999. Long Island Sound Disposal Site Study: Connecticut and New York Dredged Material Disposal Database Report and User's Manual. Prepared for the U.S. Army Corps of Engineers New England District.

Maptech. 2001. Block Island to Nantucket. Maptech Waterproof Chart 19, Edition 3.

NOAA. 2002. NOAA's National Marine Sanctuary Website May 2002. http://www.sanctuaries.nos.noaa.gov/.

O'Hara, C.J. and R.N. Oldale. 1980. Geology and Shallow Structure of Eastern Rhode Island Sound and Vineyard Sound, Massachusetts. Volume USGS Misc. Field Stud. Map MF1186. U.S. Geological Survey.

USACE. 2001. Providence Harbor and River Maintenance Dredging Project Final Environmental Impact Statement. U.S. Army Corps of Engineers. Concord, MA.

USACE. 2002. USACE 25th Anniversary of DAMOS Monitoring Conference. Held April 2002 in York, Maine. Sponsored by USACE New England District.

USACE. In prep. Rhode Island Region Long-Term Dredge Material Disposal Site Evaluation Project Task 12 F Dredging Needs Study. Maguire Group.

APPENDIX A

List of Citations and Available Abstracts

[Anonymous]. 1997. New England Cod Success. Fish Farming International. 24(8).

Abstract: A breakthrough may have brought the raising of cod a step nearer in the US, as a New England team has reported an unprecedented 30% survival rate for cod larvae. Nutritionist Linda Kling says she was surprised by the high degree of success in recent tank-rearing experiments conducted at the University of Maine. She had expected most of the larvae to die. I n collaboration with scientists at the universities of New Hampshire and Rhode Island, Ms Kling has twice repeated trials after the initial result earlier this year. "We know of no other experiment where mortality was as low as this," she said. "It raises hopes for commercial cod culturing." She believes that several factors contributed to the unusual success, among them the decision to rig full-spectrum light bulbs over the tanks. In the experiments, using cod eggs, water movement was increased and a fish density adopted different from that indicated by Norwegian trials.

Alber, M. 1988. Shellfish in Buzzards Bay: A Resource Assessment. Buzzards Bay Project Report No. 88-02. Boston University Marine Program. Woods Hole, MA. 76 pp.

Abstract: The objective of this project was to compile and evaluate shellfish catch records for Buzzards Bay, MA. This involved three major tasks: 1) determining the method used in each town for estimating catch records, based on interviews with shellfish officers and consultation with the Division of Marine Fisheries; 2) compiling information on both recreational and commercial shellfish catch reported by all towns along the Bay; and 3) doing a field assessment of shellfish stock in Buttermilk Bay, a semi-enclosed area at the head of Buzzards Bay.

The report that follows is in two parts. Part I describes catch estimation methods and presents compiled information on catch records in Buzzards Bay; part II describes fieldwork in Buttermilk Bay.

Allen, D.W., et al. 1976. Effects on Commercial Fishing of Petroleum Development off the Northeastern United States: A Study Conducted within the Marine Policy and Ocean Management Program of the Woods Hole Oceanographic Institution. Woods Hole Oceanographic Institution. Marine Policy and Ocean Management Program. Woods Hole, MA.

Abstract: This report is the result of a study of the possible effects of future offshore petroleum development on the commercial fishing industry of the New England Mid-Atlantic States. The study, made by and interdisciplinary group, was based on a variety of sources: two workshops involving fishermen, government officials and oil industry representative; visits to the Gulf of Mexico and the North Sea; interviews with state coastal zone planning officials and with federal officials responsible for offshore development; interviews with and questionnaires from working fishermen; and finally, the analysis of existing fisheries data and the review of previous studies. The report considers the effects on fisheries in three general categories: offshore interactions, onshore interactions and pollution effects. Estimates are made of the probable magnitude of these effects on commercial fishermen. Recommendations are made as to steps which should be taken by the industries and by government to minimize undesired consequences.

The report also contains general descriptions of the following: the physical environment on the continental shelf of the area; the commercial fishing industry of the Mid-Atlantic and New England regions including the ports, the fishing grounds, the fishing gear and techniques used and the results of a poll of fishermen's attitudes toward petroleum development; the technology of the petroleum industry and likely scale and pace of exploration and development in the area; the legal and regulatory framework governing the industries on the continental shelf.

Angell, T.E. and S.D. Olszewski. 2000. Rhode Island Lobster Research and Management Project; 1997 - 1999 Project Completion Report. Rhode Island Division of Fish and Wildlife.

Abstract: Biological and fishery data were collected from both inshore and offshore areas of the Rhode Island commercial lobster trap fishery. The inshore fishery area includes Narragansett Bay and Rhode Island Sound (out to approximately 20 nautical miles). Four sampling areas (upper Narragansett Bay,

Narragansett Bay-Lower East Passage, Narragansett Bay-Lower West Passage, and Rhode Island Sound) were chosen for coverage of the major lobstering areas of the inshore fishery (Figure 1A). The offshore fishery area includes mid-shelf areas (30-60 fathoms) and canyon areas (70-200 fathoms) (Figure 1B). This report contains offshore data from the canyon area only, as the mid-shelf area sampling was dropped from the project during 1993. The canyon sampling area is defined by the region along the edge of the Continental Shelf in and around Hudson Canyon.

Angell, T.E. and S.D. Olszewski. 1999. Rhode Island Lobster Research and Management Project, 1998 Annual Report / Completion Report. Rhode Island Division of Fish and Wildlife.

Abstract: Biological and fishery data were collected from both inshore and offshore areas of the Rhode Island commercial lobster trap fishery. The inshore fishery area includes Narragansett Bay and Rhode Island Sound (out to approximately 20 nautical miles). Four sampling areas (upper Narragansett Bay, Narragansett Bay-Lower East Passage, Narragansett Bay-Lower West Passage, and Rhode Island Sound) were chosen for coverage of the major lobstering areas of the inshore fishery (Figure 1A). The offshore fishery area includes mid-shelf areas (30-60 fathoms) and canyon areas (70-200 fathoms) (Figure 1B). This report contains offshore data from the canyon area only, as the mid-shelf area sampling was dropped from the project during 1993. The canyon sampling area is defined by the region along the edge of the Continental Shelf in and around Hudson Canyon.

Angell, T.E. and S.D. Olszewski. 2000. Rhode Island Lobster Research and Management Project; 1999 Annual Report / Completion Report. Rhode Island Division of Fish and Wildlife.

Abstract: Biological and fishery data were collected from both inshore and offshore areas of the Rhode Island commercial lobster trap fishery. The inshore fishery area includes Narragansett Bay and Rhode Island Sound (out to approximately 20 nautical miles). Four sampling areas (upper Narragansett Bay, Narragansett Bay-Lower East Passage, Narragansett Bay-Lower West Passage, and Rhode Island Sound) were chosen for coverage of the major lobstering areas of the inshore fishery (Figure 1A). The offshore fishery area includes mid-shelf areas (30-60 fathoms) and canyon areas (70-200 fathoms) (Figure 1B). This report contains offshore data from the canyon area only, as the mid-shelf area sampling was dropped from the project during 1993. The canyon sampling area is defined by the region along the edge of the Continental Shelf in and around Hudson Canyon.

Armstrong, M.P., J.A. Musick, and J.A. Colvocoresses. 1996. Food and Ontogenetic Shifts in Feeding of the Goosefish, *Lophius americanus*. Journal of Northwest Atlantic Fishery Science. 18:99-103.

Abstract: Food habits were studied in goosefish, *Lophius americanus*, collected off southern New England in the western North Atlantic. Analysis of stomach contents indicated goosefish fed opportunistically on a wide variety of species, primarily fishes. Invertebrates were important in the diet of small goosefish but larger goosefish fed almost exclusively on fishes. In larger goosefish a high incidence of empty stomachs was found, suggesting a low frequency of feeding. Conspecifics were a relatively important prey of larger goosefish.

Armstrong, R.S. 1998. Water Temperatures and Climatological Conditions South of New England, 1974-83. NOAA Technical Report NMFS 134. 43 pp.

Abstract: From 1974 through 1983, we conducted monitoring to provide the first long-term, year-round record of seawater temperatures south of New England from surface to bottom, and from nearshore to the continental slope. Expendable bathythermograph transects were made approximately monthly during the ten years by scientists and technicians from numerous institutions, working on research vessels that traversed the continental shelf off southern New England. Ten-year (1974-83) means and variability are presented for coastal and bottom water temperatures, for mid-shelf water column temperatures, and for some atmospheric and oceanographic conditions that may influence shelf and upper-slope water temperatures. Possible applications of ocean temperature monitoring to fishery ecology are noted. Some

large departures from mean conditions are discussed; particularly notable during the decade were the response of water temperatures to the passage of Gulf Stream warm-core rings, and the magnitude and persistence of shelf-water cooling associated with air temperatures in three successive very cold winters (1976-77, 1977-78, and 1978-79).

Asselin, S. and M.L. Spaulding. 1993. Flushing Times for the Providence River Based on Tracer Experiments. Estuaries. 16(4):830-839.

Abstract: The flushing time of the Providence River was estimated using three different data sets and three different methodologies. Dye concentrations were measured following instantaneous dye releases during wet weather experiments performed by the Narragansett Bay Project between October 1988 and June 1989. These data were analyzed to obtain flushing time estimates. Salinity measurements collected during the SINBADD cruises, Spray Cruises, and wet weather experiments were used with the fraction of fresh water method and box model to calculate flushing time.

Atlantic States Marine Fisheries Commission. 1998. Assessment of the Southern New England/Mid-Atlantic and Gulf of Maine Winter Flounder Stocks. Volume ASMFC WFTC 98-01. ASMFC Winter Flounder Technical Committee.

Abstract: Terms of reference were to update the SARC 21 VPA of Southern New England/Mid-Atlantic winter flounder (NEFSC, 1996) and to attempt to assess the status of the Gulf of Maine winter flounder stock.

Aubrey, D.G. 1979. Woods Hole Oceanographic Institute Technical Report. WHOI-79-40. Proceedings of a Workshop on Coastal Zone Research Held at Woods Hole, Massachusetts on November 27-28, 1978. Woods Hole Oceanographic Institute. Woods Hole, MA. 121 pp.

Abstract: A workshop on coastal zone research at woods hole on November 27, and 28 of 1978 brought together fifty researchers actively studying physical processes in the Massachusetts coastal zone. The presentations represented an important attempt to assess our knowledge of physical processes in the nearshore, and to encourage cooperation and communication between scientists. The recommendations that evolved were to facilitate scientist-user communication, and provide more rapid dissemination of coastal research results. Also there is a discussion on the future research in the mass coastal zone.

Aubrey, D.G. and M.R. Goud. 1983. Coastal sediment transport, Popponesset Beach, MA. Technical Report Number WHOI-83-26. Woods Hole Oceanographic Institution.

Abstract: Pathways and rates of near-bed sediment transport near Popponesset Beach, MA. were calculated using several distinct techniques. For the nearshore platform, sand transport in the form of sand waves was determined from vertical aerial photography spanning periods of four decades. In addition, calculations based on theoretical and empirical equations for near-bed sediment transport were made using field measurements of wind waves and tidal currents. Net sediment transport to the southwest inferred from these two techniques differed by about a factor of five. The higher net transport rate predicted in the aerial photographic method is a result of lack of wave measurements during storm conditions. Storm waves increase the net transport through a local increase in bed shear stress. Net transport to the southwest across the platform is between 700 and 3300 m^3/yr.

Littoral sand transport along Popponesset Beach was calculated from one month of directional wave measurements, extrapolated to a yearly value using long-term meteorological observations. Littoral transport from these calculations is 10,000 m^3/yr to the northeast, opposite the sense of alongshore transport in the shallow nearshore.

Patterns of shoreline change are discussed from a historical perspective, and using the transport calculations discussed above. Several management alternatives for coping with predicted shoreline change are presented for consideration by the Town of Mashpee.

Auster, P.J., R.J. Malatesta, and S.C. LaRosa. 1995. Patterns of Microhabitat Utilization by Mobile Megafauna on the Southern New England (USA) Continental Shelf and Slope. Marine Ecology Progress Series. 127(1-3): 77-85.

Abstract: Video transects from occupied submersibles were used to define associations of mobile megafauna (primarily demersal fishes and crustaceans) with microhabitat features including shell, burrow, biogenic depression, biogenic depression with adjacent burrow, sand wave crest, boulder, and burrowed clay outcrop. Sites were located on low-relief bottoms across the southern New England (USA) continental shelf and slope at depths of 55, 240, and 712 m. No significant diel differences in abundance were found for the 8 taxa censused at the 55 m (inner shelf) site. Non-random distributions and associations with specific microhabitats were found for the 8 taxa from diurnal transects and 6 taxa had non-random distributions from nocturnal transects. Silver hake Merluccius bilinearis and little skate Raja erinacea were associated with particular microhabitats during the day but were randomly distributed at night. These shifts in pattern are attributed to diel differences in feeding behavior. Three of 6 taxa at a 240 m (outer shelf) site and 5 of 6 taxa at a 712 m (slope) site showed non-random distributions and associations with specific microhabitats from diurnal transects. Observations with an ROV (remotely operated vehicle) at inner shelf sites (33 to 55 m) identified a distinction between species which produce biogenic depressions and species which later occupy abandoned depressions. We posit that associations with microhabitat features enhance individual fitness possibly by reducing contact with potential predators and enhancing the ability to capture prey. Use of microhabitat features occurs in assemblages where predators of focal organisms are abundant and possibly where prey density allows ambush predator tactics.

Ayers, J.C. and R.W. Crawford. 1953. The Distribution of Temperature in the Waters of Long Island Sound, Block Island Sound and Newport Bight. Cruise STIRNI - III, January - February 1952.

Abstract: Surface temperatures increased from west to east. They reached a high of 44.5° F between Montauk Point and Block Island (this value was obtained during the flood tide). From Block Island southward there was a steady increase in surface temperature until 44° F was reached at about 41° N latitude. Between Block Island and Martha's Vineyard the surface temperature varied erratically between 43.5° and 38° F.

Along the north shore of Long Island Sound cold (36°-36.5° F) waters were noted near the mouth of the Connecticut River and that of the Housatonic River. The cold water lens off the mouth of the Connecticut was especially prominent.

In the western half of Long Island Sound warmer water (37°-37.5° F) extended further westward in mid-Sound than along the north shore.

Figures 3, 4, and 5 present the vertical distribution of temperature in sections in Newport Bight, Block Island Sound, and Long Island Sound respectively. The temperature pattern in all the sections is either one of water isothermal from top to bottom or one of progressive warming from the surface downward.

Balcom, N., J. Leamon, and W.J. Bomster. 1996. Royal Red Shrimp: An Emerging Deep-sea Fishery in the Northeast. CT-SG-96-01. Connecticut Sea Grant Program, University of Connecticut. 24 pp.

Abstract: This report provides insight into the potential of a new fishery targeting royal red shrimp ("Pleoticus robustus"). The authors assess the market for and profitability of royal red shrimp caught off southern New England and the mid- Atlantic, and investigate the cost of outfitting a commercial vessel for the harvesting of this species.

Banta, G.T., A.E. Giblin, J.E. Hobbie, and J. Tucker. 1995. Benthic Respiration and Nitrogen Release in Buzzards Bay, Massachusetts. Journal of Marine Research. 53(2): 107-135.

Abstract: The decomposition of organic matter and the regeneration of nitrogen in the sediments of Buzzards Bay, Massachusetts were examined by measuring benthic fluxes of oxygen and dissolved inorganic nitrogen (DIN). Benthic respiration (O sub(2) consumption) rates measured from one site yielded an estimate of 65-80 g C m super(-2) oxidized annually. Comparing the annual release of DIN with the consumption of O sub(2) led to an estimate of N loss from the benthic-pelagic system, most likely as N sub(2) gas via denitrification, corresponding to 14-32% of the N remineralized from organic matter decomposition. Using path analysis, benthic flux rates of O sub(2) and DIN over a seasonal cycle in Buzzards Bay were determined to be related to water temperature and sediment photosynthetic pigments (chlorophyll a and phaeopigments). The rate of DIN release was also negatively related to the particulate organic N (PON) pool as well. The relationship of benthic fluxes to sedimentary pigment concentrations suggested that pigments were good indicators of labile organic matter input to sediments. Macrofauna appeared to have a direct negative effect, as well as a positive indirect effect on DIN release. Benthic respiration rates were not related to sedimentary particulate organic C (POC) or PON content, or macrofaunal abundances. Release rates of DIN were also unrelated to POC pools. Benthic flux rates measured at 12 sites in Buzzards Bay during August 1989 varied by less than a factor of 2 for benthic respiration and less than a factor of 3 for DIN release. The only environmental factor that emerged from path analysis as related (negatively) to the spatial pattern of benthic flux rates in August was water depth. Other factors, such as organic pools, pigment concentrations, macrofauna, and distance from the New Bedford sewage outfall were not related to the spatial patterns of benthic fluxes in Buzzards Bay. The combination of seasonal and spatial observations indicate that the processes oxidizing organic matter in Buzzards Bay sediments are controlled by temperature and the delivery of labile organic matter to the sediment surface. Benthic flux rates in Buzzards Bay were generally low, but N recycling efficiency was high, relative to similar coastal environments.

Barnes, J.R. 1973. Magnetic Investigations of Block Island Sound.

Abstract: This study produced a sea level total magnetic field anomaly map of Block Island Sound. Two anomalies of rather large areal extent and large amplitude are the dominant features on the map. Two dimensional model studies of the asymmetric east-west trending anomaly indicate that the anomaly could be caused by at least two different geological structures within the basement. One possibility is a sill, the other, a normal fault.

Two different methods of computing the depth to the anomaly-causing bodies indicate that the source of the anomalies is within the crystalline basement rocks. The topography of the crystalline basement rocks has little effect on the anomaly values observed.

The proximity of the two large anomalies and the apparent depths for each indicate that the two might be related. A possible solution is a batholithic intrusion within the basement under the symmetric anomaly with an associated sill projecting northwest from the intrusion.

Battelle and SAIC. 2000. Sediment Profile Sampling for the Providence River and Harbor, Final EIS. Duxbury, MA.

Abstract: A survey involving REMOTS® sediment-profile imaging was performed in November 1996 to characterize benthic habitats at nine potential dredged material disposal sites located in Narragansett Bay and Rhode Island Sound (Figure 1). A report submitted in March 1997 describes the results of that November survey (SAIC 1997a). Two additional sites (Sites 69a and 69b) were identified and surveyed in June 1997 (Figure 1). An addendum report submitted in October 1997 describes the results of the June 1997 survey of Sites 69a and 69b (SAIC 1997b). Since the June 1997 survey, the Army Corps of Engineers modified the boundaries of Sites 69a and 69b, which required full sampling coverage of the modified sites. A survey was performed in November 1999 to characterize the previously unsampled areas within each of the sites resulting from the modified boundaries.

This report presents the results of the November 1999 REMOTS® sediment-profiling imaging survey of Sites 69a and 69b. The objective of the survey was to provide information on the benthic resources and sediments of the two sites and compare the results to those obtained in previous surveys.

Bearse, D.T. 1976. Density and Distribution of the Ocean Quahog (*Arctica islandica*) in Rhode Island Waters Relative to Various Environmental Factors. M.S. Thesis. University of Rhode Island. Kingston, RI. 91 pp.

Abstract: The ocean quahog, Arctica islandica (Linne, 1767) is an important underutilized fisheries resource about which relatively little is known. It is widely distributed along the Atlantic Coast and is found in a variety of sediment types. This study was undertaken to determine those physical characteristics of the environment which most significantly affect the distribution and abundance of this species.

Reviews of the literature on A. islandica and on animal-sediment relationships in the marine environment are presented as background for the research. The sampling sites off Pt. Judith and Block Island, Rhode Island, are described, and the field and laboratory techniques are outlined.

During the summer and fall of 1975, 112 grab samples were taken at 58 stations off Pt. Judith and Block Island, Rhode Island. Eighteen variables relating to the sedimentary characteristics, depth, and organisms were measured for each grab. Measurements of length, width, whole weight, meat weight and condition index were made on each of the 129 A. islandica recovered from the grabs.

Simple and multiple linear regression and multivariate analysis (specifically discriminant analysis) of the data revealed distinct differences in the importance of certain measured variables in explaining the distribution and abundance of A. islandica between the two areas studied. These differences between Pt. Judith and Block Island suggest that no clear-cut extrapolations to other locations can be made concerning the distribution and abundance of this species relative to the variables measured.

Beccasio, A.D., G.H. Weissberg, A.E. Redfield, R.L. Frew, W.M. Levitan, J.E. Smith, and R.E. Godwin. 1980. Atlantic Coast Ecological Inventory User's Guide and Information Base. FWS/OBS 80/-51. U.S. Fish and Wildlife Service Biological Services Program. Washington, DC. 163 pp.

Abstract: Plans for new major energy facilities along the Atlantic coastline of the United States have recently conflicted with the protection of valuable coastal fish and wildlife species and their habitats. Conflicts arose during the recent proposed siting of oil refineries in Maine and Virginia. In Eastport, Maine, the conflict centered around the siting of a proposed refinery in an area where numerous bald eagles nest and other valuable resources occur. The siting of a proposed refinery on the Chesapeake Bay at Portsmouth, Virginia, was opposed primarily because the resources were already under stress. The area supports extensive oysterbeds and a blue crab overwintering area.

To reduce further conflicts, such as those which occurred in Maine and Virginia, the U.S. Fish and Wildlife Service (FWS) has conducted an ecological inventory to assist industry in their advanced planning and evaluation procedures. FWS's intent was to lessen the chance for serious dispute during the later permit review evaluation process. This study resulted in 31 fish and wildlife coastal inventory maps (referred to in this report as maps) and a User's Guide and Information Base (referred to as the report). This is the first phase of an effort by FWS to provide planners and industry officials with the appropriate assistance and guidance in their plans for environmental protection. The maps reduce the potential for conflict by depicting areas of resources that are most ecologically or economically valuable and that could be most vulnerable to the construction and operation of energy-producing facilities. In addition, the maps should be of assistance in reducing environmental damage from energy facilities at any location along the Atlantic coast.

Beckers, C. 1969. Report on Oceanographic Data Analysis and Interpretation and the Evaluation of Existing and Proposed Oceanographic Data Systems. University of Rhode Island. Kingston, RI.

Bedard, A. 1970. The Zonation of *Littorina littorea* (Linnaeus) Extent and Limitations. M.S. Thesis. Southern Massachusetts University. North Dartmouth, MA. 24 pp.

Berlinsky, D.L., M.C. Fabrizio, J.F. O'Brien, and J.L. Specker. 1995. Age-at-maturity Estimates for Atlantic Coast Female Striped Bass. Transactions of the American Fisheries Society. 124(2): 207-215.

Abstract: This study was undertaken to estimate the percentage of mature female striped bass Morone saxatilis present in each age-class during annual coastal feeding migration. Migratory striped bass (N = 302) were sampled in coastal Rhode Island waters during spring (May-June) and fall (September-November) from 1985 to 1987. Stocks were identified by analysis of morphometric characters and isoelectric focusing of eye-lens proteins. Histological sections of ovarian tissue were used to categorize maturity state. Fish were considered mature if a class of oocytes measuring at least 150 mu m and containing cytoplasmic inclusions was found in the ovarian sections. All females whose age at next potential spawning was 7 and older were mature. Our empirical observations indicated that 12% of fish in age-class 4, 34% of fish in age-class 5, and 77% of fish in age-class 6 were mature. The estimate of the proportion of mature fish in age-class 5 differs significantly from that of Merriman (1941), who also examined coastal migrants. No significant differences were found in maturity estimates of fish from stocks of different origin.

Bertness, M.D., S.D. Gaines, D. Bermudez, and E. Sanford. 1991. Extreme Spatial Variation in the Growth and Reproductive Output of the Acorn Barnacle *Semibalanus balanoides*. Marine Ecology Progress Series. 75(1):91-100.

Abstract: Geographic variation in secondary production can profoundly influence population and community processes yet is rarely studied in benthic marine organisms. In this paper, we document striking variation within and among locations in the growth and reproductive output of the acorn barnacle Semibalanus balanoides and discuss the potential consequences of our results on understanding recruitment and other population processes. Within Narragansett Bay (Rhode Island, USA) barnacle growth and reproduction is far greater than at nearly open coast locations. At comparable tidal heights, recruits in the Bay grew to nearly twice the basal diameter and had almost 10 times the reproductive output compared to recruits on the open coast. Transplant experiments suggest that the high secondary production of Bay barnacles is largely a phenotypic response to high primary production. Within- and among-site patterns in barnacle secondary production associated with enhanced flow velocities were also conspicuous.

Bertness, M.D., S.D. Gaines, and R.A. Wahle. 1996. Wind-driven Settlement Patterns in the Acorn Barnacle *Semibalanus balanoides*. Marine Ecology Progress Series. 137(1-3):103-110.

Abstract: We quantified daily larval settlement of the acorn barnacle Semibalanus balanoides in a small embayment within Narragansett Bay, Rhode Island, USA, to examine the hypothesis that local wind patterns influence shoreline settlement. Daily larval settlement and the accumulation of barnacle recruits were both strongly correlated with local wind patterns within and among years. When prevailing winds were out of the south, larval settlement was enhanced on the northern side of the bay, whereas when winds were out of the north, larval settlement was enhanced on the southern side of the bay. These patterns were observed

Bertness, M.D., G.H. Leonard, J.M. Levine, P.R. Schmidt, and A.O. Ingraham. 1999. Testing the Relative Contribution of Positive and Negative Interactions in Rocky Intertidal Communities. Ecology. 80(8):2711-2726.

Abstract: Habitat amelioration by canopies of the seaweed Ascophyllum nodosum and its consequences on understory organisms in the Gulf of Maine were studied. By reducing heat and desiccation stresses, especially at high tidal heights, algal canopies exerted a positive effect on the distribution and abundance of benthic organisms. At stressful high tidal heights, canopy effects on understory organisms were largely positive, but, at lower, more benign, tidal heights, canopy effects were wholly negative or statistically neutral. These observations emphasize the prominent role that habitat-modifying organisms can play in communities and provide support for the hypothesis that the nature and strength of interspecific species interactions very much depend on the physical environment in which they take place.

Bertoni, R.S. 1974. Geological and Geophysical Investigation of Block Island Sound between Fishers and Gardiners Islands.

Abstract: The Sangamonian Gardiners sequence, because of its marine origin, represents the only key horizon among the glacial deposits of Long Island and southeastern New England. As such, it has long served as a datum in the interpretation of the Pleistocene history throughout the district. There is strong evidence, however, that the Gardiners beds may indeed represent deposits of limited areal extent and that the previously held regional correlation of clay and sand outcrops in the area needs reevaluation. The lack of fossils and the distinctly rhythmic character of the sediment suggest that numerous clay beds at the type and locality and on Fishers Island represent the product of sedimentary processed younger than and unrelated to the Sangamon interglacial. Seismic profiling, coring, and onshore sampling were carried out. Analysis of these data resulted in several conclusions. (1) A well-developed drainage system generally trending in a N-S direction exists in the basement surface and in the younger Cretaceous strata underlying western Block Island Sound. (2) The inshore limit of Cretaceous Coastal Plain beds in a steep escarpment trending NE-SW and rising several tens of meters above the basement surface. (3) The Gardiners sequence is discontinuous under Block Island Sound and a considerable stratigraphic hiatus characterizes the sedimentary column north of the escarpment. (4) The clay beds of Fishers Island are not correlative with the Gardiners clay. (5) There is strong evidence favoring the idea of proglacial lakes having occupied large portions of Block Island and Long Island Sounds during the final stages of Pleistocene glaciation. (6) Thick sections of unfosiliferous rhythmites underlie northwestern Block Island Sound and apparently represent the only deposits rising on the Paleozoic crystalline basement.

Bigelow, H.B. and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. U.S. Fish and Wildlife Fishery Bulletin. 77:1-576.

Bilyard, G.R. 1987. The Value of Benthic Infauna in Marine Pollution Monitoring Studies. Marine Pollution Bulletin. 18(11):581-585.

Abstract: Analysis of benthic infauna (organisms retained on 0.5 mm 1.0 mm mesh screens) is a key element of many marine and estuarine monitoring programs. But sample sorting and taxonomy are labor-intensive, and benthic infauna have recently been deleted from some monitoring programmes for reasons of cost alone. Because benthic infauna provide valuable information that cannot otherwise be obtained, deletion of this monitoring program component is often a serious mistake. Benthic infauna provide fundamental data that are relevant to general objectives of most marine monitoring programmes. Moreover, that are especially important components of monitoring programmes because they are sedentary and they respond to pollutant stresses.

Blais, A.G. 1986. Geological Aspects of Shoreline Management: A Summary for Southern Rhode Island. III. Spatial and Temporal Variations of a Microtidal Beach: Charlestown Beach, Rhode Island. Vol. 3A. Plotted profiles. Dept. of Geology, University of Rhode Island. RI.

Blanchard, F.S. 1961. Block Island to Nantucket: Narragansett and Buzzards Bays; Block Island, Vineyard and Nantucket Sounds. D. Van Nostrand Company, Inc. Princeton, NJ. 253 pp.

> **Abstract:** Detailed description of 80 harbors and yachting areas along the shores of Block Island, Vineyard, and Nantucket Sounds and Little Narragansett, Narragansett, and Buzzards Bay. Each yachting area is described from a general point of view and the recent past of the areas compared to their present (1961) time. Contains information of practical value and historic interest.

Bleakney, J.S. 1965. Reports of marine turtles from New England and eastern Canada. The Canadian Field-Naturalist. 79:120-128.

> **Abstract:** Marine turtles are considered to be tropical or subtropical and their occurrence in northern waters is typically dismissed as accidental. The standard reference books of Carr (1952), Conant (1958), and the more recent *Introduction to Herpetology* by Goin and Goin (1962) leave one with the impression of tropical marine turtles being just that. However, recent personal observations and a search of the literature revealed 112 documented coastal records of marine turtles from Newfoundland to Connecticut (Table 1) with an indication of a seasonal occurrence. A reappraisal of the status of these turtles in the cold waters of Eastern Canada and New England is presented here.

Blumer, M., J. Sass, G. Souza, H.L. Sanders, J.F. Grassle, and G.R. Hampson. 1970. The West Falmouth Oil Spill: Persistence of the Pollution Eight Months after the Accident. Technical Report Submitted to the Office of Naval Research. Woods Hole Oceanographic Institution. Woods Hole, MA.

> **Abstract:** A spill of 650,000 - 700,000 liters of #2 fuel oil has contaminated the coastal areas of Buzzards Bay, Mass. The present report summarizes the results of our continuing chemical and biological study which were available at the end of May 1970, more than eight months after the accident.
>
> The effects of environmental exposure on the composition of the oil are discussed; many analytical parameters are sufficiently stable to permit continued correlation of the oil remaining in sediments and organisms with the fuel oil involved in the spill.
>
> Oil from the spill is still present in the sediments, inshore and offshore and in the shellfish. A further spread of the pollution to more distant offshore regions has occurred during midwinter; as a result, the pollution now covers a much larger area than immediately after the accident. The first stages of biological (presumably bacterial) degradation of the oil are now evident especially in the least polluted regions; however, it has depleted predominantly the straight and branched chain alkanes. The more toxic aromatic hydrocarbons are resistant; as a result, the toxicity of the oil has not been diminished.
>
> Where oil can be detected in the sediments there has been a kill of animals; in the most polluted areas the kill has been almost total. Shellfish that survived the accident have taken up the fuel oil. The 1970 crop of shellfish is as heavily polluted as was last year's crop. Oysters transplanted to unpolluted water for as long as 6 months retained the oil without change in composition or concentration.

Boehm, P.D. 1983. Polychlorinated Biphenyl (PCB) Analytical Survey of Buzzards Bay, Massachusetts. Final Report to NOAA/NMFS, Contract NA-81-FA-C-0013. Energy Resources Co., Inc. Cambridge, MA.

Boehm, P.D. and J.G. Quinn. 1977. Hydrocarbons in Sediments and Benthic Organisms from a Dredge Spoil Disposal Site in Rhode Island Sound. Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency. Narragansett, RI.

Boothroyd, J.C., M.F. Dacey, and M.J. Rosenberg. 1986. Geological Aspects of Shoreline Management: A Summary for Southern Rhode Island. I. Regional Depositional Systems and a Long-term Profiling Network. Dept. of Geology, University of Rhode Island. Kingston, RI.

Boothroyd, J.C., C.W. Galagan, and S.M. Graves. 1988. Advance and Retreat of the Southern Rhode Island Shoreline, 1939-1985; Including 1985 Berm Volume. Dept. of Geology, University of Rhode Island. RI.

Abstract: The southern shoreline of Rhode Island consists of a series of headland/upland, and barrier spit/lagoon systems. In an alongshore direction, headlands are 0.8–2.5 km in length; barrier spits are 1.3–4.9 km long. Measurements of the area enclosed by adjacent shore-normal transects (mean spacing 300m alongshore) and the mean high water lines on successive vertical aerial photographs, were used to calculate annual erosion/deposition rates. Both short (10, 6 and 4 yr) and long-term (46 yr) rates of change in the position of the high water line were calculated. Short-term erosion and deposition rates are variable and an order of magnitude larger than long-term rates. Long-term rates show the south shore to be erosional with retreat of the high water line, occurring at 81 of the 89 shoreline segments. Barrier spit segments eroded at rates generally greater than headland segments. Long-term retreat rates show that headlands protruding seaward of the barriers are non, or less, erosional on the west-facing shore, and more erosional on the east-facing shore. This trend can be reversed over shorter time periods depending upon predominant drift direction.

Measurements of berm width (taken from the most recent set of vertical aerial photographs, March 11-27, 1985) and berm heights (from transit surveys) were used to calculate a berm volume for each of the 89 shoreline segments. Berm volume per meter per segment is calculated to aid in comparing relative berm volumes along the shoreline. In addition, berm volumes are calculated for each of 15 physiographic units (headlands and barriers) containing the 89 shoreline segments, as well as volume per meter for the various physiographic units.

Overall, barrier spit shoreline segments have larger berms than do headland segments. Berm volumes among the shoreline segments range from < 1,000 ml to > 45,000 ml. The smallest berm volumes (per segment) are found at Green Hill and Matunuck headlands. The largest volumes appear along the Weekapaug-Quonochontaug barrier, followed by portions of the East Beach barrier and at the western end of the Charlestown barrier. Berm volume per meter per shoreline segment ranges from < 6 mł to > 10 ml·m¯ą. These second derivative values confirm that the Weekapaug-Quonochontaug barrier has the greatest berm volumes for any length equivalent area along the south shore. This is due to the higher berm top elevation. The next largest volumes per meter alongshore can be found in the immediate vicinity of the jetty-stabilized inlets of Charlestown, and the Harbor of Refuge at Pt. Judith. A total berm volume for the entire south shore of Rhode Island from Watch Hill Point to Point Judith is 972,610 mł, with an average of 29.57 ml·m¯ą.

Bothner, M.H., E.C. Spiker, P.P. Johnson, R.R. Rendigs, and P.J. Aruscavage. 1981. Geochemical evidence for modern sediment accumulation on the continental shelf off southern New England. Journal of Sedimentary Petrology. 51(1):281-292.

Abstract: An area of fine-grained sediment approximately 170 km × 74 km in size, located in water depths between 60 m and 150 m, south of Martha's Vineyard, Mass., is a site of modern sediment deposition. The ^{14}C ages systematically increase with sediment depth from about 1,300 years B.P. at the surface to 8,000–10,000 years B.P. at the depth of maximum core penetration. The old age for the surface sediments probably results from a combination of deposition of old carbon and faunal mixing. In the finest sediments, the sedimentation rates were approximately 130 cm/1,000 yrs when deposition began and have decreased to about 25 cm/1,000 yrs. The decreasing sedimentation rate reflects a diminishing source of fine sediments, which presumably came from the Georges Bank and Nantucket Shoals area.

Inventories of excess ^{210}Pb in undisturbed cores average 70 dpm/cm² (disintegrations per minute per square centimeter), more than two times higher than the flux of ^{210}Pb from the atmosphere and from ^{226}Ra decay in

the overlying water. This additional influx of ^{210}Pb either must be with new fine-grained sediment material or from solutions that are stripped of their ^{210}Pb by particulates in the bottom nepheloid layer. Stable Pb concentrations in surface sediments are about 28 ppm, as much as two times higher than concentrations at depth.

The high accumulation rates, ^{210}Pb inventories, and trace-metal profiles imply that this area is a modern sink for fine-grained sediments and for pollutants associated with particulate matter in the water column. To our knowledge, this is the only site of present-day natural deposition on the Continental Shelf off the eastern United States, exclusive of the Gulf of Maine. Because the net currents on the outer half of this Continental Shelf flow from northeast to southwest, this fine-grained deposit may receive its sediments and possible contaminants from the Nantucket Shoals and Georges Bank region.

Bourne, D.W. and J.J. Govini. 1988. Distribution of Fish Eggs and Larvae and Patterns of Water Circulation in Narragansett Bay, 1972-1973. American Fisheries Society Symposium. 3:132-148.

Bowman, M.J. and W.E. Esaias. 1981. Fronts, Stratification, and Mixing in Long Island and Block Island Sounds. Journal of Geophysical Research. 86 (C5):4260-4264.

Abstract: Spatial patterns of bulk stratification in Long Island and western Block Island sounds observed near the fall equinox of 1978 show a strong correlation (r = o.79) with contours of the *h/U* stratification index derived from tidal stream and depth carts. The index delineates stratified, transitional, and mixed regions with apparent good accuracy, with the marginally stratified frontal zones being characterized by log 10 *h/U* ~ 1.5 m s . These results and theoretical considerations suggest that the index may be a useful parameter in corroborating and predicting frontal boundaries in other moderately stratified estuaries where local buoyancy fluxes are derived from fresh water sources.

Bowman, M.J., W.E. Esaias, M.B. Schnitzer, and H.G. Mirchel. 1979. Cruise Data Report, R/V Ridgely Warfield, Long Island and Block Island Sounds: September 13-21, 1978. Marine Sciences Research Center, State University of New York. Stony Brook, NY.

Abstract: This data report presents hydrographic, wind, chlorophyll a, light extinction and nutrient data taken in Long Island and Block Island Sounds, September 13-21, 1978 aboard the R/V Ridgely Warfield.

This cruise formed part of a continuing series of experiments designed to investigate the role of tidal stirring, stratification, nutrient fluxes and light levels on primary productivity in shallow seas. The R/V Ridgely Warfield was on charter from the Chesapeake Bay Institute of the Johns Hopkins University, Baltimore.

Bowman, R.E. and W.L. Michaels. 1984. Food of Seventeen Species of Northwest Atlantic Fish. NOAA Tech. Memo. NMFS-F/NEC-28. 183 pp.

Abstract: The stomach contents of 16,631 fish representing 17 species common to Northwest Atlantic continental shelf waters have been analyzed. Fish were collected during annual spring and autumn bottom trawl surveys conducted in offshore waters between Cape Hatteras, North Carolina, and Western Nova Scotia in the years 1973-1976. Major types of food are determined by examining the diet of predators according to fish length and within geographic areas. A complete listing of items identified in the stomachs of each species, and yearly and seasonal differences or similarities in the quantity and type of prey are discussed. Examination of stomach contents revealed some species of prey were widespread while others were more characteristic of a particular geographic area. Organisms of major importance as prey were identified.

Bowman, R.E., C.E. Stillwell, W.L. Michaels, and M.D. Grosslein. 2000. Food of Northwest Atlantic Fishes and Two Common Species of Squid. NOAA-TM-NMFS-NE-155. 160 pp.

Abstract: This paper provides a reference document for researchers interested in the types of prey eaten by fishes and two common species of squids if continental shelf waters off the northeastern United States. The stomach contents of 31,567 individuals representing 180 species were analyzed. Collection of specimens was primarily by bottom trawl or longline during 1963-84. Most of the smaller-sized fish species (*i.e.*, < 100 cm long) and the two squid species were collected by bottom trawl during 1977-80. Most of the apex predators, including the large sharks and tunas, and other large-sized species were collected by longline. Dietary data are initially presented as a summary table, which lists for each of 170 predators the relative contribution of six major functional prey groups (*i.e.*, fish, squid, polychaete, decapod crustacean, other crustacean, and all other) to its diet. Such data are subsequently presented as summary tables which list for each of those six functional prey groups the predators involved and the relative contribution of seven geographic areas (*i.e.*, Middle Atlantic, Southern New England, Georges Bank, Gulf of Maine, Scotian Shelf, inshore north of Cape Hatteras, and south of Cape Hatteras) to each predator's consumption of that functional prey group. Also, appendix tables provide a detailed listing of the overall stomach contents for each predator species and, for selected species, the stomach contents according to predator size, or to both predator size and geographic area of collection.

Boyd, J.R. 1991. The Narragansett Bay Shellfish Industry: A Historical Perspective and an Overview of Problems of the 1990s. In: Proceeding of the First Rhode Island Shellfisheries Conference. Narragansett, RI, August 27, 1990. Rhode Island Sea Grant. 105 pp.

Brady-Campbell, M.M. 1982. An Assessment of the Productivity of Two Species of Laminaria (Phaeophyta, Laminariales) in Narragansett Bay and Rhode Island Sound. Masters Thesis. University of Rhode Island.

Abstract: The annual primary productivity of *Laminaria saccharina* and *L. digitata* has been assessed in Narragansett Bay and Rhode Island Sound. Productivity was calculated from monthly measurements of standing crop, density and growth within the kelp beds from April 1980 to June 1981. *L. Saccharina* exhibited a mean daily growth rate of 0.85 c.day , with maximum growth occurring from February to June and an annual blade length turnover of 3.5 times. The mean annual standing crop at two stations in Narragansett Bay was 779±79 gDW.m (median = 513 gDW.m), and in Rhode Island Sound the mean standing crop was 1092± 182 gDW.m (median = 536 gDW.m).. The mean annual density was 156 individual.m (median = 60 individuals.m _ for *L. saccharina* and *L. digitata* combined, of which *L. saccharina* comprised 77 to 100% of this density. In Rhode Island Sound kelp density was 95±23 individual m (median = 50 individuals.m) with *L. saccharina* comprising 93 to 100% of the density. The mean carbon content in March 1981 was 29% of the dry weight of the kelp tissue. Integrating the information from these measurements, a mean annual primary productivity of 2366 gC.m .yr (median = 962 gC.m .yr) was calculated for the kelp community in Narragansett Bay and 1099 gC.m .yr (median = 577 gC.m .yr) in Rhode Island Sound. The mean productivity of kelp is eight times the phytoplankton productivity in lower Narragansett Bay. The median productivity of kelp is three times greater than that of phytoplankton. The distribution of the kelp, however, was limited to portions of the lower Bay, resulting in an overall production 1 to 2 orders of magnitude less than that measured for phytoplankton. If the primary productivity of the *Laminaria* spp. were adjusted for the large portion of non-predatory losses and release of spores, the calculated contribution of these two species of macroalgae would increase considerably. In addition to significant biomass and primary production, these kelp also provided a habitat for a unique periphyton community.

Brannon, J.M., R.E. Hoeppel, T.C. Sturgis, I. Smith, Jr., and D. Gunnison. 1985. Effectiveness of Capping in Isolating Contaminated Dredged Material from Biota and the Overlying Water. Technical Report D-85-10, NTIS No. AD-A165 251. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

Abstract: The effectiveness of capping in chemically and biologically isolating contaminated dredged material was investigated using large- and small-scale laboratory reactor units. The ability of various cap materials to isolate contaminated dredged material was assessed in the large reactor units by following the movement of chemical contaminants and microbial spores contained in the capped dredged material into the overlying water column and by monitoring the biological uptake of chemical contaminants by class and polychaetes. The depth of cap material needed to chemically isolate contaminated dredged material was assessed in the small-scale reactor units.

Bricelj, V.M. and R.E. Malouf. 1984. Influence of Algal and Suspended Sediment Concentrations on the Feeding Physiology of the Hard Clam *Mercenaria mercenaria*. Marine Biology. 84:155-165.

Abstract: Short-term laboratory feeding experiments were conducted to determine the response of the hard calm Mercenaria mercenaria (L.) (32 mm in mean shell length) to increasing sediment concentrations.. Clams were fed mixed suspensions of Pseudoisochrysis paradoxa (50 and 150 cells 1) and bottom sediments (0 to 44 mg 1). Algal ingestion rate declined with increasing sediment loads. This resulted primarily from a reduction in clearance rate, which declined by 0.08 1h-1g-1 (1.3%) for every 1 mg 1-1 increase in sediment loads. This reduction was of similar magnitude for juvenile (13mm) clams. At the algal concentrations tested, pseudofaeces production was intermittent and inconspicuous below about 10 mg silt 1 . Loss of algae in pseudofaeces increased with increasing sediment loads; however, even at the highest silt and algal concentrations, clams lost a maximum of only 18% of the algae cleared from suspension. Thus, pseudofaeces production is not expected to cause significant loss of algal food at the sediment concentrations normally encountered in the natural environment (ca 40 mg silt l^{-1}). Absorption rate of total organic matter remained constant, at least up to silt concentration of 20 mg 1-1. Experiments using dual ^{51}Cr:^{14}C-formaldehyde-labelled sediment indicated that calms were able to counteract the dilution of algae by absorbing a considerable fraction (21 to 22%) of detrital sedimentary organics. Absorption efficiency of pure P. paradoxa ranged from 82% at 50 cells l^{-1} to 58% at 150 cells l^{-1}. Integration of physiological rate measurement suggests that at moderate to high algal concentrations (300 g $C1^{-l}$), growth improvement by the addition of silt, documented in mussels, surf clams and oysters, is unlikely to occur in M. Mercenaria. It is suggested that a suspension-feeding bivalve's success in maximizing its energy gain in a turbid environment depends on the combination of two features: a high selection efficiency and a high rate of pseudofaeces production. It is proposed that species which regulate ingestion primarily by producing pseudofaeces are better adapted to cope with high suspended sediment loads than species such as M. mercenaria, which control ingestion mainly by reducing clearance rate.

Bricelj, V.M., R.E. Malouf, and C. de Quillfeldt. 1984. Growth of Juvenile *Mercenaria mercenaria* and the Effect of Resuspended Bottom Sediments. Marine Biology. 84:167-173.

Abstract: The influence of silt on growth of juvenile hard clams Mercenaria mercenaria (L.) (9 mm in mean shell length) was investigated in the laboratory using mixed suspensions of algae (50 x 10 Pseudoisochrysis paradoxa cells 1). Growth rates, expressed as percent increase in ash-free dry tissue weight, were not significantly affected by sediment concentrations up to 25 mg 1 . Significant reduction in growth (by 16% relative to controls fed only algae), and condition of clams, occurred at 44 mg silt 1-1. The results of the 3-week growth experiment agree well with predictions made in an earlier study by integrating results of short-term physiological measurements. Growth rates obtained with experimental algal-silt diets at 21C (2.6 to 3.3% increase in dry tissue weight d-1) were comparable to those determined at ambient concentrations of Great South Bay particulates at 20 /c (0.9 to 4.0% d). Levels of particulate inorganic matter in seawater from Great South Bay, New York, exhibited pronounced daily changes, and ranged from 6 to 126 mg dry weight 1 . Growth enhancement by the addition of silt to an algal diet, reported in mussels, surf clams and oysters, was not found in M. mercenaria. It is suggested that these

three species are better suited than hard clams for culturing efforts in inshore turbid waters above uncompacted, muddy bottoms.

Bricelj, V.M., M.A. Rice, and D. Grossman-Garber. (Eds.). 1993. Aspects of the Biology of the Northern Quahog, *Mercenaria mercenaria*, with Emphasis on Growth and Survival during Early Life History. Pages 29-48 pp In: Proceedings of the Second Rhode Island Shellfish Industry Conference. Narragansett, Rhode Island, August 4, 1992. Rhode Island Sea Grant. Narragansett, Rhode Island.

Abstract: Key features of the biology of *Mercenaria mercenaria* are reviewed with emphasis on early life history processes. Predatory mortality during juvenile stages of the northern quahog is identified as a primary factor controlling recruitment of natural populations. Predation rates are shown to be strongly modulated both by substrate preference and prey-size selectivity of major predators (crabs and carnivorous gastropods). Smaller xanthid crabs prefer heterogeneous substrates (gravel and shell bottoms), and consume quahogs at a higher rate in these substrates, whereas larger, portunid crabs prefer and forage most effectively in homogeneous substrates. In contrast to predictions of optimal foraging theory, even larger crabs preferentially consume smaller quahogs, when a wide range of prey sizes is available, thus increasing predation pressure on smaller quahog size classes.

Under field conditions, at near-optimum temperatures, juvenile *M. mercenaria* exhibit mean shell growth rates of 0.8 mm week^{-1} (maximum = 1 mm wk^{-1}). Native populations along the east coast exhibit comparatively lower and higher than average lifetime growth rates at the species' northern (Prince Edward Island, Canada) and southern (Florida) distributional limits, respectively. These extremes correlate with the length of the growing season, which is strongly temperature-dependent. Thus, the time to attain legal market-size ranges from 1.9 $\geq$ 6 years and averages three to four years in the mid-portion of the northern quahog's latitudinal ranges (Massachusetts to Virginia). Up to a two- to three-fold variation in growth rates is typically observed within a single estuary. Three toxic/noxious algal species are identified as potentially harmful to *M. mercenaria* under bloom conditions: the chrysophyte *Aureococcus anophagefferens*, the chlorophyte *Nannochloris atomus* , and the dinoflagellate *Alexandrium fundyense*. Management implications and suggested fruitful directions for future research are discussed throughout the text.

Bricker, S.B. 1990. The History of Metals Pollution in Narragansett Bay as Recorded by Salt Marsh Sediments.

Abstract: Sediment cores from 5 salt marshes from the head to the mouth of Narragansett Bay and an additional core from a lagoon on Block Island Sound were analyzed for 210Pb and for Fe, Mn, Cu, Pb, Cr, Zn, Ag, and Ni in order to examine the long-term variation of metal inputs to Narragansett Bay. The 210Pb results were used to determine accretion rates for each core. The distributions of Fe and Mn were used as indicators of the chemical conditions in the sediment cores and the Cu, Pb, Cr, Zn, Ag, and Ni distributions over time were compared to known or estimated source inputs to examine the long-term variation of pollutant metal inputs to Narragansett Bay.

Briggs, S.R., D.M. Rubin, and J.B. Southard. 1981. Spatial Variations in Sand-wave Size and Migration Rate; Implications for Shoal Dynamics. American Association of Petroleum Geologists Bulletin. 65(5):906.

Abstract: Spatial patterns of sand-wave size and migration rate were carefully monitored using side-scan sonar and narrow-beam echo sounding on Southwest Middle Ground Shoal in Vineyard Sound, Massachusetts, from March 22 to November 16, 1978. Navigation was provided by an acoustic-transponder system with a positioning accuracy of 3 m.

Sand waves migrate obliquely upshoal from depths greater than 19 m to depths less than 11m. Erosion at depths less than 16 m is caused by a downcurrent increase in the sediment-transport rate, represented by a twofold increase in bed-form height that more than offsets a small decrease in migration rate. Deposition farther downcurrent, above 16 m, is caused by a downcurrent decrease in sediment-transport rate,

manifested by downcurrent decreases in both bed-form height and migration rate. These bed-form-size trends are consistent with a kinematic control on bed-form size that causes bed forms to grow or shrink while they acquire or lose sediment owing to erosion or deposition.

The observed pattern of erosion on the shoal's lower flanks, and of deposition on the upper flanks and crest (a constructional phase of shoal dynamics), may be seasonal because the period of our study did not include the more energetic winter months. Alternatively, this constructional pattern may occur during all seasons, and only be balanced by such major storm events as hurricanes, which would transfer sediment from the shoal crest to its lower flanks.

Briggs, S.R. and J.B. Southard. 1980. Tidal-current Sand Waves in Vineyard Sound, Massachusetts. AAPG Bull. 64(5):681.

Abstract: Response of bed forms to tides and storms was studied for 8 months on Middle Ground Shoal, Vineyard Sound, Massachusetts, which has a nearly bi-directional tidal ellipse parallel with the shoal axis. Bed forms are on three scales: sand waves (H, one to several m; λ, 20 to 200 m), megaripples (H, up to 1 m; λ, 1 to 20 m) and ripples ($H < 10$ cm; $\lambda < 1$ m). Ripples are superimposed on both sand waves and megaripples; megaripples are commonly superimposed on large sand waves. Four transponder-navigated surveys with ± 1 m accuracy were made with 200 kHz narrow-beam echo sounding and side-scan sonar. Successive charts of sand-wave crest positions were inter-compared to measure sand-wave migration. One wave at the edge of the sand-wave field was studied during several deployments of a tetrapod instrumented with four acoustic-travel-time velocity sensors at 30, 50, 100, and 300 cm from the bed, a bottom camera, and a 4-mHz sonic profiler to record bed heights. Sand waves show a slight upslope component of migration. Flood and ebb waves are separated by a 100 to 200-m belt of symmetrical waves at the shoal axis; some crests are continuous across the entire shoal. Flood or ebb migration ranged from 2 to 28 m during the 8-month period, but certain segments of waves migrated much more than other segments. Superimposed megaripples, which migrate too rapidly for survey-to-survey correlation, were monitored by divers using a staked and measured line over a sand wave; these forms, with H up to 1 m and λ up to 20 m, migrated a full wavelength in up to several weeks.

Browder, J.A. 1994. GLM Analysis of Medium Bluefin Tuna Relative Abundance in the Western North Atlantic Based on Rod and Reel CPUE. Collect. Vol. Sci. Pap. ICCAT. 42(1):223-228.

Abstract: A general linear modeling (GLM) approach was used to develop an index of abundance of medium bluefin tuna (Thunnus thynnus) based on the catch per unit of effort (CPUE) in the U.S. North Atlantic coast rod and reel fishery. Operating primarily on the continental shelf, the fishery extends from North Carolina to Maine, but medium bluefin primarily are caught off New Jersey, New York, and southern New England during the summer and early fall. CPUE in this fishery varies principally as a function of year, area, time of year, fishing method (*i.e.*, chum or troll), and whether the effort is a tournament activity. An annual index of abundance was produced for the years 1987 through 1992, extending a previous GLM analysis of medium bluefin CPUE through 2 more years.

Brown, A.F. 1995. Molecular Ecology and Biogeography of the Acorn Barnacle *Semibalanus balanoides*. Brown University. 86 pp.

Abstract: The acorn barnacle, *Semibalanus balanoides*, is the focus of classic ecological and evolutionary investigations. Also, *S. balanoides* has been the center of investigations of population differentiation with biogeography. Previous studies involving this barnacle have used life history traits, morphology, and protein variation.

I investigated the ecology and biogeography of *S. balanoides* by analyzing neutral mitochondrial DNA (mtDNA), which allows the study of evolutionary change due to random genetic drift. The primers that I used for PCR amplification of the mtDNA control region and its sequence are described in Chapter 1.

Because this region is highly suitable for studies of genetic differentiation among populations, I hope that researchers studying similar questions in arthropods will be able to use these primers.

In Chapter 2, I investigate whether strong selection and limited gene flow can lead to habitat-specific population differentiation among *Semibalanus balanoides.* This barnacle lives in a wide array of habitats, which differ in a many selective pressures. In general, it is assumed that species with planktonic larval dispersal are unable to adapt to microhabitats. I analyzed the mitochondrial control region from barnacles living in different ecological habitats to determine if barnacles were locally adapted. I found that gene flow is wide and that there is no evidence of habitat-specific population differentiation at this DNA region.

In Chapter 3, I explore the biogeography of *S. balanoides* across its range, again analyzing the mtDNA control region. I found that barnacle populations are clearly differentiated between the Pacific and Atlantic Oceans but are not genetically distinct across the Atlantic Ocean. There was little genetic variation within the northern North American samples compared to the southern New England barnacles, suggesting wide and directional gene flow along the western Atlantic coast.

In Chapter 4, I investigate the phylogenetic relationship of *S. balanoides* among barnacles using the CO1 gene of the mtDNA. Although my results place this species where predicted, I find evidence of phylogenies among other sessile barnacles that is quite different than expected based on morphology.

Brown, B. and J. Gale. 1986. Identification and Collection of Historic Data for Buzzards Bay, Massachusetts. Buzzards Bay Project Report. Battelle Ocean Sciences. Duxbury, MA. 60 Pages + appendices.

Brown, B. and J. Neff. 1993. Bioavailability of Sediment-bound Contaminants to Marine Organisms. NOAA, National Ocean Pollution Program Office, Rockville, MD.

Abstract: An evaluation of the bioavailability ("the degree to which a chemical can be taken up by a living organism by biological or physical and chemical processes") of different forms of chemicals in different environmental compartments to marine organisms. Reviews the forms and reactivity of contaminants, metals and organics, life styles and feeding habits of benthic animals, food chain transfer and possible biomagnification. Not a review of the toxicology of contaminants.

Brown, B., T. Stenner, and J. Gale. 1987. Identification and Collection of Historic Data for Buzzards Bay, Massachusetts: Summary of Existing Literature. Buzzards Bay Project Report. Battelle Ocean Sciences. Duxbury, MA. 142 pp.

Brubaker, K.L. and J.H. Byrne. 1989. Zero Tolerance: Reducing Toxic Pollution in Narragansett Bay. Save the Bay. Providence, RI.

Abstract: In 1986, Save The Bay published "*Down The Drain: Toxic Pollution and the Status of Pretreatment in Rhode Island,*" reporting that 700,000 pounds of toxic metals were being dumped into Rhode Island sewers each year. Now, four years after programs were to be implemented reducing the amount of toxic materials being released, Save The Bay has re-evaluated the effectiveness of pretreatment programs in Rhode Island. It was determined that more than 80 percent of the toxic discharge to the Bay continues to come from the Narragansett Bay Commission. Examination of these records in detail suggests a significant reduction in toxic loadings in recent years. However, the Narragansett Bay Commission still received approximately 32 percent more toxic metals that it would if pretreatment regulations were obeyed.

Buckley, L.J., A.S. Smigielski, T.A. Halavik, E.M. Caldarone, B.R. Burns, and G.C. Laurence. 1991. Winter Flounder *Pseudopleuronectes americanus* Reproductive Success. 2. Effects of Spawning Time and Female Size on Size, Composition and Viability of Eggs and Larvae. Marine Ecology Progress Series. 74(2-3):125-135.

Abstract: Vital statistics and embryo and larval viability were determined for winter flounder Pseudopleuronectes americanus spawning in Narragansett Bay, Rhode Island, USA, over the course of the spawning season. Fish approaching spawning condition were collected throughout the spawning season and hand-stripped in the laboratory. Larvae were reared through the first month of life. Female size affected most of the reproductive parameters examined, including both absolute and relative measures of total reproductive output (reproductive rate and gonadosomatic index), egg size, fecundity, and viability. Spawning time was found to affect egg size, fecundity, and viability, but not reproductive rate or gonadosomatic index. Egg size increased with increasing female size and decreased as the spawning season progressed. Spawning time and female size explained 61% of the observed variability in egg size among females. Female size explained 95% of the variability in reproductive rate and 90% of the variability in fecundity.

Buckley, L.J., A.S. Smigielski, T.A. Halavik, E.M. Caldarone, B.R. Burns, and G.C. Laurence. 1991. Winter Flounder *Pseudopleuronectes americanus* Reproductive Success. 1. Among-location Variability in Size and Survival of Larvae Reared in the Laboratory. Marine Ecology Progress Series. 74(2-3):117-124.

Abstract: Winter flounder Pseudopleuronectes americanus collected at selected locations in Long Island Sound (LIS), New York, and Narragansett Bay (NB), Rhode Island, USA, were spawned in the laboratory and the larvae reared for a month after hatching. In 1987 the average size of yolk-sac larvae varied widely among locations. Moreover, a direct correlation was observed between size of yolk-sac larvae and survival for the first month of life. Fish from NB produced the smallest larvae with the lowest survival rate. The Madison site in LIS produced the largest yolk-sac larvae with the highest survival rate. Size and biochemical composition (g larva) of yolk-sac larvae were correlated. Dry weight and RNA content were the best predictors of survival potential among the variables considered (protein, DNA, lipid content, and RNA/DNA ratio). In 1988 little difference was observed in viable hatch or weight of yolk-sac larvae among locations. While no significant difference in larval survival was observed between NB and LIS fish, survival was higher in the Madison group than the Morris Cove group from LIS. These data suggest that when differences in size among newly hatched larvae are sufficiently large, survival potential can be affected.

Bugley, K.E. and A.H. Carr. 1994. Massachusetts Coastal Waters: The Status and Potential for Artificial Reefs. Bulletin of Marine Science. 55(2-3):1330-1331.

Abstract: In the past 30 years various, private interest groups have proposed constructing artificial reefs in Massachusetts coastal waters; only one gained approval from the permitting agencies. In 1978, the Division of Marine Fisheries assisted the town of Yarmouth with planning and monitoring of an artificial reef in Nantucket Sound. The reef was designed to enhance fisheries by providing desirable habitat for certain finfish and lobsters in a relatively barren area, and to render a constructive means of utilizing old tires. Reef monitoring was undertaken with the aid of SCUBA diving, side scan sonar, and user group surveys from 1978 to 1981. Monitoring results indicated successful structure stabilization, colonization of macrobiota (*e.g.*, algae, invertebrates and attraction of target finfish) and improved conditions for recreational angling. During the summer of 1991, we reevaluated the Yarmouth tire reef and reviewed the status of other artificial structures, notably old shipwrecks that have attracted fish and anglers. Many of these shipwrecks have deteriorated to the point where their contribution as future fishing sites remains in doubt. Degradation of existing reefs, the success of the Yarmouth tire reef, and continued interest in proposing new reefs reveals the need for development of a formal Massachusetts artificial reef policy and program. Such a program would improve monitoring methods, increase the opportunity for planned fisheries research projects and contribute to the overall management goals of Massachusetts's marine fisheries.

Bulman, C.A. and W. Grant. 1986. Potential Biological Effects on Sediment Transport and Bottom Flows in Coastal Embayments. Page 11. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1458.

Bumpus, D.F., R.E. Lynde, and D.M. Shaw. 1973. Physical Oceanography. In: Saila, S.B., (Ed.), Coastal and Offshore Environmental Inventory: Cape Hatteras to Nantucket Shoals. Marine Publication Series No 2. University of Rhode Island, Kingston, RI. 72 pp.

> **Abstract:** This chapter covers the physical oceanographic parameters from Nantucket and Vineyard Sounds, Buzzards Bay, Narragansett Bay, Long Island Sound, and other southern estuaries in the Middle Atlantic Bight ranges. These parameters include temperature gradients, salinity, tidal currents and circulation, tidal oscillation, and storm tides and waves.

Bumpus, D.F., W.R. Wright, and R.F. Vaccaro. 1971. Sewage disposal in Falmouth, Massachusetts. II. Predicted effect of the proposed outfall. Journal of the Boston Society of Civil Engineers. 58:255-277.

> **Abstract:** The proposed addition of nearly 4 million gallons per day of effluent, from a secondary sewage treatment plant in Falmouth, to Vineyard Sound off Nobska Point is evaluated by means of current measurements, dilution estimates, and potential stimulation of phytoplankton growth. In terms of current usage no impairment of the water quality is indicated.

Butman, B. 1987. Physical Processes Causing Surficial-sediment Movement, in Georges Bank. Pages 147-162 In: Backus, R.H., (Ed.), Georges Bank. MIT Press, Cambridge, MA.

> **Abstract:** Describes the physical causes of bottom-sediment resuspension and movement on Georges Bank and the adjacent continental shelf and slope. The spatial distribution, temporal variability, and causes of near-bottom currents strong enough to initiate sediment movement and the effects of this movement on the distribution of surface sediments are presented. Sediment resuspension and transport not only affect the distribution of natural sediments but also have important implications for the biology and chemistry of the bank as well as for the bank's use.

Butman, B., R. Signell, P. Shoukimas, and R.C. Beardsley. 1988. Current Observations in Buzzards Bay, 1982-1986. Data Report. U.S. Department of the Interior Geological Survey Open File Report 88-5.

> **Abstract:** Buzzards Bay is a semi-enclosed embayment located along the southeastern coast of Massachusetts. Between 1982 and 1986, the U.S. Geological Survey and the Woods Hole Oceanographic Institution made current and other observations at several locations throughout the bay. The major objective of these observations was to obtain a general description of the circulation, near-bottom flow and sediment movement in the bay. Much of the research was motivated by the discovery of PCB contamination of the sediments in New Bedford Harbor. Little was know about the processes that might transport these substances throughout the Bay if they escaped from the harbor or were dredged and dumped at some location in the bay.

Butman, C.A. 1989. Sediment-trap Experiments on the Importance of Hydrodynamical Processes in Distributing Settling Invertebrate Larvae in Near-bottom Waters. Journal of Experimental Marine Biology and Ecology. 134(1):37-88.

> **Abstract:** The hypothesis that planktonic larvae of benthic invertebrates sink through the water like passive particles in turbulent flows near the seabed was tested in the field by exploiting biased sampling characteristics of sediment traps. Field experiments were conducted at two sites, 10- and 14-m depth, in Buzzards Bay, Massachusetts, U.S.A., and traps were moored 0.4-1.6 m above the seabed. In experiments during four field seasons, with deployments lasting from several hours to 11 days, trap collections of Mediomastus ambiseta (Hartman) polychaete postlarvae, total bivalve larvae and postlarvae, spionid/sabellariid polychaete larvae (individuals too small to identify definitively to family), spionid

polychaete larvae, enteropneust larvae, and gastropod larvae nearly always corresponded to a priori predictions for passive particle collections between sediment-trap designs. If larvae sink like passive particles to within 0.4-m of the seabed, as results of this study suggest, then it is possible that larvae initially reach the seafloor at sites where particulates, with fall velocities similar to larvae, initially settle.

Cáceres, C.E. and N.G. Hairston Jr. 1998. Benthic-pelagic Coupling in Planktonic Crustaceans: The Role of the Benthos. Ergebnisse der Limnologie. 52:163-174.

Abstract: The population dynamics of many species of zooplankton are strongly tied to the benthos through their dormant egg banks. As a result of this link, populations of planktonic organisms may be affected not by the water-column community, but by benthic organisms as well. investigations of egg bank dynamics in two lakes we observed a variety of ways in which dormant zooplankton may be impacted by the benthic assemblage. Our observations are representative of the diversity of possible interactions of this type. In Oneida Lake, NY, USA, the ability of invertebrates to consume Daphnia diapausing eggs was examined in laboratory experiments. Amphipods readily ingested the ephippia whereas gastropods, turbellarians, chironomids and zebra mussels did not. Gut analyses performed on amphipods collected from Oneida Lake indicate that these animals eat ephippia in the field as well. In Bullhead Pond, RI, USA, a large fraction of the diapausing eggs produced by the copepod Diaptomus sanguineus are retained on macrophytes for up to five months before either hatching or sinking to the sediment. Eggs that reach the nearshore sediment may be redistributed by sunfish as they build their nests. Larval caddisflies in both lakes were found to use dormant stages in the construction of their cases. Because the effect of benthicpelagic coupling on zooplankton population dynamics are species and system specific, a consideration of the processes influencing both the active and dormant fractions is needed to understand fully zooplankton dynamics.

Cadrin, S.X. 1995. Discrimination of American Lobster (*Homarus americanus*) Stocks off Southern New England on the Basis of Secondary Sex Character Allometry. Canadian Journal of Fisheries and Aquatic Sciences. 52(12):2712-2723.

Abstract: Male American lobster (Homarus americanus) from inshore southern New England were discriminated from offshore males on the basis of larger relative chela size. Lobsters from Buzzards Bay (inshore) had more conspicuous sexual dimorphism than lobsters from Hydrographer Canyon (offshore), and allometric growth of male chelae was more prominent than that of female abdomens. Principal components analysis of males from combined stocks represented variability in multivariate size and relative chela size, and component score distributions of each stock were discrete. Principal components of females from both stocks comprised variability in overall size and relative abdomen size, but principal component scores overlapped extensively. Multiple-group principal component 2 was a size-free index of relative chela size that classified 96% of males to the correct stock. Multiple-group principal component 2 of females did not successfully separate stocks. Discriminant analysis of size-adjusted morphometric data classified males to stock with 100% accuracy on the basis of relative chela size. Although discrimination of size-adjusted female data classified stocks with 94% accuracy, it was less stable and not associated with onset of maturity.

Cadrin, S.X., A.B. Howe, S.J. Correia, and T.P. Currier. 1995. Evaluating the Effects of Two Coastal Mobile Gear Fishing Closures on Finfish Abundance off Cape Cod. North American Journal of Fisheries Management. 15(2):300-315.

Abstract: A 16-year time series of research trawl catches, commercial landings, and effort data were used to evaluate two areas protected from mobile gear fishing off Cape Cod, Massachusetts, and assess effects of the spring otter trawl fishery for longfin squid *Loligo pealeii* on local abundance of finfish frequently caught as bycatch. Catch rates were compared between a seasonal closure, a permanent closure, and adjacent waters open to mobile gear fishing. Winter flounder *Pleuronectes americanus* and scup *Stenotomus chrysops* were more abundant in the two protected areas. Black sea bass *Centropristis striata* and windowpane *Scophthalmus aquosus* were more abundant in the seasonal closure but not in the

permanent closure. Abundance indices of summer flounder *Paralichthys dentatus* and longfin squid were not significantly different between the seasonal closure and the exploited area but both species were less abundant in the permanent closure. Little skate *Raja erinacea* were more abundant in areas open to trawling. Significantly lower catch rates of the latter four species in the permanent closure indicated that habitat differences were important in determining local abundance. Decreased local density of finfish in open areas was not related to inshore spring squid trawling effort or landings. Regional trawl effort on Georges Bank and in southern New England did have significantly negative effects on local finfish density. Inferences of causal relationships between the inshore squid fishery and decreased local abundance of finfish were not supported. These results suggest that inshore abundance of these species is more related to total regional trawl effort.

Calabro, R.B. 1997. Coastal Geologic Hazards and Future Shoreline Change, Southern Rhode Island Shoreline: Implications for Management.

Abstract: Five Rhode Island barrier/headland complexes were studied to determine patterns in morphology and response to storms, how each area will respond to frontal erosion and sea level rise, and what effects these processes have on the management of these areas. Weekly beach profiles from the Rhode Island South Shore show that beaches change on different time scales, and that they respond to storms according to antecedent beach shape, the storm's characteristics, and the timing of storm events. The other study areas located on Aquidneck Island contain fine grained, dissipative beaches, showing little spatial and temporal variability. They are more flexible during storm events that the South Shore beaches, which are more reflective, showing higher rates of erosion over time.

Three methods were used to model shoreline configuration and barrier/headland transect migration to the years 2050 and 2100. Of these three methods, the Sediment Budget Method (SBM) allowed for the most accurate portrayal of the evolution of barrier and headland systems. This method allowed for direct calculation of source erosion, balancing it with sink deposition along the barrier and headland. The Historical Erosion Method (HEM) and the National Research Council Method (NRC) are both based on a direct translation of barrier features, creating shoreline configuration that cannot be maintained due to the lack of sediment input. The HEM tends to over-project sink deposition, whereas the NRC method over-projects source erosion. The SBM is the most suited for use along sediment-starved shorelines, such as southern Rhode Island.

Of the five study areas Misquamicut Headland, Charlestown Barrier, South Kingstown Town Beach (Matunuck Headland), First Beach Barrier in the City of Newport, and Second and Third Beach Barriers in the Town of Middletown the best management practices have been implemented in South Kingstown. High erosion rates in this area have necessitated the use of recreational facilities that are elevated, and flexible within the geologic processes of the shoreline. The area most susceptible to coastal erosion is the Misquamicut Headland, largely because of a history of shoreline development in this area. This area has a large storm-hazard potential, and many businesses are precariously located behind poorly designed shoreline protection structures. Some action will need to be taken to protect this community from future storm damage. The Charlestown Barrier can be preserved as a recreational resource by allowing the backbarrier to respond naturally to sea level rise and increased overwash.

The Town of Middletown and the City of Newport on Aquidneck Island have low-lying barriers that are subject to very elevated storm-surge flooding. All structures located on these barriers should be elevated above the wave envelope of the current Federal Emergency Management Agency V-zones. The backbarrier, because it is constrained by dikes, is less stable than the Charlestown Barrier, for example, and will need to be able to rise naturally in step with sea level. Infrastructure should not be expanded, and existing roads and parking lots should be surfaced in gravel or crushed stone to maintain flexibility. Management policy should be based not only on the 100-year storm, but also on storms of small magnitude such as a 10- or 20-year storm. The towns of Misquamicut, Charlestown, South Kingstown, Newport, and Middletown, can all benefit from basing their management activities on a knowledge of local geologic processes.

Calder, D.R. 1996. Hydroids (Cnidaria: Hydrozoa) Recorded from Depths Exceeding 3000 m in the Abyssal Western North Atlantic. Canadian Journal of Zoology. 74(9):1721-1726.

Abstract: Hydroid diversity and abundance appear to be low in the mid-abyssal zone of the western North Atlantic Ocean. Only two species (Acryptolaria longitheca, Opercularella sp.) were collected during investigations by submersible (Deep Submergence Vehicle Alvin) at depths between 3011 and 3550 m along the northwest slope of the Bermuda Pedestal in March 1993. Moreover, bottom samples from 59 deep stations (all >3000 m) between southern New England and Bermuda, collected by the Woods Hole Oceanographic Institution Benthic Ecology Program between 1961 and 1973, contained just two hydroid specimens (both referred here to Halisiphonia megalotheca). Of some 424 species of hydroids currently recognized from the western North Atlantic, only 8 have ever been reported in the region from depths exceeding 3000 m. One of these (Cryptolarella abyssicola) has been recorded from the North and South Atlantic, North and South Pacific, and Southern Ocean, and another (Halisiphonia megalotheca) from the North and South Atlantic, North and South Pacific, and southern Indian Ocean. The other six (Stylactaria ingolfi, Eucuspidella pedunculata, Opercularella sp., Halecium dubium, Acryptolaria longitheca, and Aglaophenopsis verilli) have been reported exclusively from the North Atlantic. The hydroid fauna of the mid-abyssal zone may be sparse compared with that of neritic waters, but it is less frequently sampled and remains poorly known.

Callaghan, D.W. and R.A. Comerford. 1978. The Economic Impact of Commercial Fishing on the State of Rhode Island, 1975. Submitted to the Rhode Island Governor's Task Force on Fisheries. Marine Technical Report 65. University of Rhode Island. [Kingston, RI].

Abstract: Seventy-two responses from firms engaged in Rhode Island's commercial fishing activity (exempting fish retailers) were analyzed in an input-output framework to determine their impact on the state's economy. Results of the three-month study will by summarized, first, by describing the overall multiplier; second, by explaining the set of general multipliers; and third,, by presenting major interdependency coefficients of direct and indirect effects.

The overall multiplier for Rhode Island's fishing industry is 424. This means that for every $100 of fish landed in the State, $424 worth of economic activity is stimulated. Were such multipliers available for other industries, the relative economic contribution of the fishing industry could be determined.

General multipliers for fin fishermen (FIN), lobstermen (LOB), shellfishermen (MOL), processors and handlers and packers (HP&P), and non-Rhode Island vessels (NRIV) are 252, 253, 276, 267, and 109, respectively. These figures represent the total dollar flows, which ripple through the state's economy as a result of each sector selling $100 of additional product to final consumption. For example for every $100 of additional product sold by HP&P to buyers located outside the state and to household consumers, $267 in total economic activity is generated in Rhode Island. To evaluate the relative magnitude of these multipliers, we can compare them with their equivalents for the "average" non-fishing industry in the state, represented in the study by the category entitled "Other Economic Activity" (OEA). The general multiplier for OEA is only $163. So we can conclude that for every $100 delivered to final demand, FIN contributes 55 percent more economic activity than the "average" non-fishing industry, LOB also contributes 55 percent more, MOL contributes 69 percent more, and HP&P, 64 percent. These figures must be coupled with total output measures, however; industries cannot be compared solely on the basis of interdependency coefficients. Total output of OEA in Rhode Island, of course, was much greater than total output of the fishing industry.

The total contribution to the state's economy by NRIV is only $109.31 for every $100 work of sales to final demand. However, these vessels' sales of fish to HP&P amount to almost half as much as sales by Rhode Island fishermen. In other words, non-Rhode Island vessels are providing nearly one-third of all the fish to Rhode Island handlers, packers, and processors. This means that if the fish presently delivered to HP&P by NRIV could be provided instead by Rhode Island fishermen, then an increase of approximately $150 in total economic benefits per $100 of output would be realized by the state.

A more detailed analysis of the interrelationships among the various sectors studied can be undertaken by examining interdependency co-efficients (Table 3). For every $100 increase in fish bought by all purchasers who buy fish from Rhode Island handlers, packers and processors, FIN would have to produce and additional $21.22 worth of fish; LOB would have to supply an additional $13.12 worth of lobsters; and MOL would have to make available an additional $5.29 worth of mollusks. Other businesses in Rhode Island collectively would have to produce an additional $46.20 worth of their products and state and local governments would receive $8.22 in revenues. Finally, $52.26 in additional personal income would be generated throughout the state's economy and NRIV would have to deliver an additional $18.10 worth of fish to Rhode Island.

As we did with general multipliers, we can compare interdependency coefficients for fishing sectors with other industries in the state. For a $100 increase in deliveries to final demand, FIN, LOB, and MOL would contribute between $72.51 and $99.54 to households as direct and indirect personal income payments. Other industries would contribute only $32.80, Similarly, FIN, LOB, and MOL would contribute between $10.82 and $12.26 to Rhode Island governments, whereas the average Rhode Island industry would contribute only $5.86.

All of the various coefficients presented in this report (Tables 2 through 5) present information on the economics of the state's fishing industry. Each one provides insight into an aspect of the industry. They are too numerous, however, to be discussed individually. Within the report, directions are provided as to how to read and interpret the various tables.

Generalizations from the elements of the results described in this abstract are as follows:

1. The overall multiplier for Rhode Island's fishing industry is 424. This means that as fish flow from fishermen to consumer (both inside and outside the state), $424 in economic activity is generated for every $100 in fish landed.

2. On a per-dollar-of-output basis, Rhode Island's fishing industry (excluding fish retailing) contributes approximately 60 percent more to the state's economy than the "average" industry. Consequently, a policy-induced increase in output of the fishing industry would generate significantly greater economic returns to the state than it would if directed at the "average" industry. This statement assumes that the fish would be available for such an increase and that they could be sold.

3. If the fish presently supplied to Rhode Island's HP&P by NRIV were provided by in-state vessels, then an increase of approximately $150 in total economic benefits per $100 of landed fish would be realized in the state.

In terms of contributions to personal income of Rhode Island residents per $100 of output, the sectors of the fishing industry provide more than twice as much as the average non-fishing industry, and as much as 30 times more than non-Rhode Island vessels.

Campbell, J.W. and J.E. O'Reilly. 1988. Role of Satellites in Estimating Primary Productivity on the Northwest Atlantic Continental Shelf. Continental Shelf Research. 8(2):179-204.

Abstract: Variance in primary productivity over the Northwest Atlantic continental shelf has been studied to determine its dependence on variables amenable to satellite remote sensing. A large data set consisting of super(14)C uptake rates, chlorophyll concentrations, incident and underwater light (PAR) and sea surface temperatures was analyzed for empirical and theoretical relationships. These data were obtained at 1047 stations surveyed by the National Marine Fisheries Service between 1977 and 1982 as a part of the MARMAP program. The authors conclude that the goal of estimating primary productivity from satellite measurements requires improved techniques for measuring and/or modeling the PAR absorbed by photosynthetic organisms.

Caporale, D.A., B.F. Beal, R. Roxby, and R.J. Van Beneden. 1997. Population Structure of *Mya arenaria* along the New England Coastline. Molecular Marine Biology and Biotechnology. 6(1):33-39.

Abstract: Sequences of the internal transcribed spacer (ITS-1) ribosomal DNA region were compared among 88 soft-shell clams (Mya arenaria) from 12 sites (within three general areas) along the New England coast to determine whether populations were genetically heterogeneous. Two sequence variants were observed, with type 1 having a 3-nucleotide insertion and one point mutation relative to type 2. Allele-specific polymerase chain reaction (PCR), using primers specific to each sequence type, was performed to determine the distribution of individuals who had both allelic forms. DNA from soft-shell clams collected from three areas (Cobscook Bay, Maine; Gulf of Maine; and southern New England) were compared. chi super(2) analyses of allele-specific PCR results revealed no significant heterogeneity among the three population distributions.

Cardwell, R.D., C.E. Woelke, M.I. Carr, and E.W. Sanborn. 1976. Sediment and Elutriate Toxicity to Oyster Larvae. Pages 684-718 In: Krenkel, P.A., J. Harrison, and J.C. Burdick II. (Eds.), Proceedings of the Specialty Conference on Dredging and its Environmental Effects. Mobile, Alabama, January 26, 1976-January 28, 1976. American Society of Civil Engineers. New York.

Carr, A. 1986. New perspectives on the pelagic stage of sea turtle development. NOAA Tech. Memo. NMFS-SEFC-190. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center. Panama City, FL. 36.

Abstract: Thirty years ago when interest in sea turtles was beginning to spread, the habitat of the post-hatchlings for all the species was unknown. After they left the nest and made their way through the surf, they simply disappeared. Very slowly, data to suggest a pelagic life in a sargassum weed habitat accumulated, and eventually I received support to investigate that idea intensively. By the end of that research period it was clear that when sargassum rafts are present in longshore arrays within the swimming range of the hatchlings, they do in fact enter them (Carr 1982). It followed that the early developmental stages are pelagic, with the corollary that, because sargassum accumulates along convergences, the adjacent currents may carry the rafts and their occupants on journeys of either local or oceanic extent or both.

Until lately the so-called lost-year puzzle seemed mainly an academic concern. It has now become clear, however, that the missing pelagic stage is more protracted than was initially believed, and that during this time the turtles are brought into intimate contact with concentrated marine pollution. Growing awareness of the steady spread of marine debris and pollutants, of the tendency of these to collect along frontal driftlines, and of the habit of hatchlings to eat virtually any small object within reach, made closer investigation of this phase of sea turtle life seem urgent. Cruises and aerial searches for sargassum lines were made, and hundreds of interviews with seamen and commercial and sports fishermen were carried out. As understanding of the aims of the investigation spread, reports from sea-going people and volunteer collaborators began to lend substance to the sargassum theory of hatchling ecology. Besides the numerous specific records obtained, there were many other occasions when, in casual or group conversation, it was heard that "at some times of the year you see little turtles in the berry grass." Table 1 provides substantial (though partial) documentation of the case for a pelagic and driftline habitat for young sea turtles.

Carr, A. 1986. Rips, FADS, and little loggerheads. BioScience. 36(2):92-100.

Abstract: Fronts, or driftline, at sea play a vital role in the "lost years" of Atlantic and Pacific sea turtle species. Years of research have told us much about the behavioral ecology of sea turtles, but mysteries remain.

Carr, A. 1967. So Excellent a Fishe. A Natural History of Sea Turtles. Natural History Press. Garden City, NY.

> **Abstract:** Table of Contents received: (1) The Turtle Mountain; (2) Tagging Turtles; (3) Señor Reward Premio; (4) A Hundred Turtle Eggs; (5) *Arribada;* (6) The Way to *Isla Meta*; (7) Sea Turtles and the Future

Carr, H.A., A.J. Blott, and P.G. Caruso. 1992. A Study of Ghost Gillnets in the Inshore Waters of Southern New England. Pages 361-367 In: MTS '92: Global Ocean Partnership. Proceedings Marine Technology Society Conference. Washington, DC, October 19, 1992-October 21, 1992. Marine Technology Society. Washington, DC.

> **Abstract:** The effect of lost (ghost) gillnets on fish stocks has been a concern of fisheries managers for some time. This study was designed to assess the impact of simulated ghost gillnets on inshore fish populations, and to look at modifications to nets which might solve the derelict net problem. A control and three experimental gillnets were set in southern New England inshore waters. They were observed by divers using still and video cameras over a two-year period. Findings indicated that nets remaining on the bottom continue to fish even when the vertical profile has been reduced. However, the species makeup of the catch changes with a reduction in net height. The greatest reduction in fishing ability of lost gillnets seems to be due to the net's increased visibility to fish, which comes with fouling, physical destruction, and entanglement of the net.

Casterlin, M.E. and W.W. Reynolds. 1982. Thermoregulatory Behavior and Diel Activity of Yearling Winter Flounder, *Pseudopleuronectes americanus* (Walbaum). Env. Biol. Fish. 7(2):177-180.

> **Abstract:** Sixteen yearling winter flounder, tested individually for 3-day periods in electronic shuttleboxes, voluntarily occupied an 8-27° C range of temperature, with a modal final thermal preferendum of 18.5° C (mean 18.7°° C, median 19° C, midpoint 17.5°C, s.d. 1.9° C, S + 0.33). The locomotor activity pattern of the yearling fish in the laboratory was markedly nocturnal, with mean hourly nocturnal activity exceeding mean hourly diurnal activity by a factor of 3.4 Maximum activity occurred at 0300 EST, minimum activity at 1400 EST. While activity generally increased with temperature, a local activity minimum occurred at 18.7°C, coinciding with the 24-hour mean final thermal preferendum. Comparison of these laboratory data with previously published field data suggest that behavioral responses to temperature and light play significant roles in determining age- and size-specific differences in seasonal depth stratification and onshore-offshore distributions in this species.

[Anonymous]. 1996. Castro, K., Corey, J. DeAlteris, and Gagnon C. (Ed./Compiler), Proceedings of the East Coast Bycatch Conference. Newport, Rhode Island, April 7, 1995-April 8, 1995. Rhode Island Sea Grant. Narragansett, RI.

> **Abstract:** Table of Contents received: (1) Bycatch Implications and Strategies; (2) An East Coast Industry Perspective on Bycatch; (3) A Panel and Audience Discussion Focusing on Bycatch on the East Coast; (4) Successes and Failures of Bycatch Reduction Strategies; (5) Regional Bycatch Discussion: Presentation and Summary

Castro, K.M. and T.E. Angell. 2000. Prevalence and Progression of Shell Disease in American Lobster, *Homarus americanus*, from Rhode Island Waters and the Offshore Canyons. Journal of Shellfish Research. 19(2):691-700.

> **Abstract:** From 1995 to 1999, shell disease in lobsters, Homarus americanus, was monitored in research trawl and trap surveys conducted in Rhode Island waters including Narragansett Bay, Rhode Island and Block Island Sound, and the offshore areas of Block and Hudson Canyons. In the inshore population a significant increase in frequency and severity of the disease was documented beginning in 1996, reaching 20% infected by 1999 with over 50% of ovigerous females affected. Shell disease was noted in the offshore lobster population beginning in 1998. A tag-recapture study conducted in Narragansett Bay between 1997

and 1999 followed the change in severity over a 3-year period in the field for 86 individuals. Observed disease pathways point to potential affects for reproductive behavior and mortality. The proportion infected with disease appeared to diminish over the molting period, but subsequently increased in infection rate and shell coverage during the months of September and October.

Castro, K.M., J.S. Cobb, R.A. Wahle, and J. Catena. 2001. Habitat addition and stock enhancement for American lobsters, *Homarus americanus*. Marine & Freshwater Research. 52:1253-61.

Abstract: Six experimental artificial reefs for lobsters were established in Narragansett Bay, Rhode Island, in February 1997. These have been monitored according to a 'before-after-control-impact' design since placement by means of visual surveys, traps, tag-recapture, photoquadrats, and airlift sampling. Juvenile and adult lobster density at the reef increased from near zero to >1 lobster m^{-2}, significantly higher than the two control areas. Settlement of young-of-year lobsters has significantly increased. We used microwire tags to mark hatchery-reared lobsters, and released over 2000 marked 5th–6th–stage lobsters in each of two years. The density of young-of-year lobsters on enhanced reefs was not different from that on the control reefs. Despite intensive sampling, we have recovered only one of the hatchery-reared animals. Field observations indicate possible behaviour differences in the hatchery-reared lobsters that might make them more susceptible to predation.

Chinman, R.A. and S.W. Nixon. 1985. Depth-area-volume Relationships in Narragansett Bay. NOAA/Sea Grant Marine Technical Report 87. Graduate School of Oceanography, University of Rhode Island. 64 pp.

Abstract: In spite of the fact that Narragansett Bay is among the most frequently studied bodies of coastal marine water in the world, no detailed hyposographic analysis of the system has yet been published. This publication reports the results of such an analysis for Narragansett Bay, including bathymetric contour charts, the area, volume, mean depth, and shoreline length for various subregions of the bay, cross-sectional areas in a number of places along the bay, the bathymetric profiles of transects along the passages of the bay, and the cumulative volume of the bay as a function of increasing distance from various points.

Circe, R.C., A.G. Dahl, and J.S. Booth. 1984. Geotechnical Index Properties of Surficial Sediments from Central Buzzards Bay, Massachusetts. Open-file Report, U.S. Geological Survey. 7 pp.

Clancy, M. and J.S. Cobb. 1991. Abundance of Cancer Crab *Megalopae* and the Potential Ramifications to Population Regulation. Journal of Shellfish Research. 10(1):304-305.

Abstract: The rock crab Cancer irroratus and Jonah crab C. borealis , are dominant members of the decapod community in the North Atlantic from Nova Scotia to the Mid Atlantic Bight. It appears that Cancer crab populations in Block Island Sound, Rhode Island, may operate under different constraints and use different recruitment strategies than other commercially important crab species. Densities of C. magister and Callinectes sapidus megalopae are typically reported as 0.1/m super(3). Cancer) megalopae in Block Island Sound are estimated to exceed hundreds/m super(3) in the plankton, at least three orders of magnitude greater. Evidently, either fecundity is much higher in the North Atlantic Cancer) species, or larval wastage at the zoeal stage is low. The literature suggests that fecundity does not differ markedly among these species. Thus, the observed abundances must be a result of unequal larval mortality or some other physical or behavioral mechanism. The ramifications of these differences relative to population regulation will be discussed.

Clancy, M. and J.S. Cobb. 1997. Effect of Wind and Tidal Advection on Distribution Patterns of Rock Crab C*ancer irroratus* Megalopae in Block Island Sound, Rhode Island. Marine Ecology Progress Series. 152(1-3):217-225.

Abstract: The planktonic period of benthic marine invertebrates can significantly affect distribution patterns of benthic juveniles. In this paper we address the relationship between advection and the

subsequent abundance of planktonic megalopae of the rock crab Cancer irroratus in Block Island Sound, Rhode Island (USA), over an 8 yr period. At small scales (several meters distance with samples taken simultaneously), megalopae were found to be similarly distributed; at larger temporal (tens of minutes) and spatial scales (hundreds of meters) megalopae were very patchy, which indicates a complex, highly variable pattern of abundance typical of planktonic systems. Using the receptor-mode trajectory capability of OILMAP, a numerical hydrodynamic model, we detected a significant relationship between the direction of transport prior to collection (as predicted by the model) and the subsequent catch of megalopae. We argue that rock crab megalopae are often advected tens of kilometers over short time spans and are concentrated on south-facing shores in Block Island Sound. Further, enhanced planktonic delivery to our study area results in large pulses of individuals to the benthos. Directional transport would be an effective larval delivery strategy even if rock crab megalopae were subject to lower advection, perhaps owing to a deep vertical distribution; a significant relationship between transport direction and collection date was detected even under a lower advective regime.

Clancy, N., J.P. Grassle, A. Kelsey, E. Oates, and P.V. Snelgrove. (Eds.). 1995. Environmental and Population-specific Contributions to Growth Rate Variation in the Marine Amphipod *Jassa marmorata*. In: Twenty-Third Benthic Ecology Meeting. March 17, 1995-March 19, 1995. New Brunswick, NJ.

Abstract: In order to understand the ecological and evolutionary significance of intraspecific life history variation, the sources of that variation need to be determined. Reciprocal transplant experiments were used to distinguish between environmental and population-specific (genotypic) variation in growth rates of the marine amphipod Jassa marmorata. Experiments were conducted at two sites within Narragansett Bay, Rhode Island during May and August 1993. Hatchlings were collected, measured and randomly assigned to enclosures. Repeated measures ANOVA of standardized growth rates revealed significant effects of both environment and source population during the May experiment, but no significant effect were detected in the August experiment.

Coastal Services Center. 1998. NBNERR Data Recovery Project [Computer Laser Disk]. Coastal Services Center, National Oceanic and Atmospheric Administration. Washington, DC.

Abstract: NOAA funded a project as part of a national pilot program of data sharing among the National Estuarine Research Reserves. The project identified, digitized, and rescued historical Narragansett Bay data and metadata, which were in danger of being lost. The data were organized and burned to CD Rom to make it easily available. The CD was developed to provide coastal zone data and information as understandable assessments and implementable information for policy makers and the public in Rhode Island.

Coates, P.G., A.B. Howe, and A.E. Peterson, Jr. 1970. Analysis of Winter Flounder Tagging of Massachusetts, 1960-1965. Massachusetts Department of Natural Resources, Boston Division of Marine Fisheries, National Marine Fisheries Service. Washington, DC. 82 pp.

Cobb, J.S., K. Castro, R.A. Wahle, and J. Catena. 1998. An Artificial Reef for Lobsters (*Homarus americanus*) in Rhode Island, USA. MSG-R-98-17. Pages 75-78 In: Gendron, L. (Ed.), Proceedings of a Workshop on Lobster Stock Enhancement. Magdalen Islands (Quebec), October 29, 1997-October 31, 1997. 135 pp.

Abstract: Management of a fishery often includes attempts to enhance the resource either by supplying additional individuals or by supplying additional habitat as artificial reefs. In the case of lobster (Homarus americanus) the concept of larval production and release makes sense if the supply of larvae is considered to be limiting and habitat is not saturated. In contrast, if habitat is thought to limit population size, enhancement efforts might be directed towards provision of more suitable (rocky) substrate for juveniles and adults. In 1997, researchers established six experimental reefs on a mud-shell bottom in Narragansett Bay, Rhode Island. Here they describe the purpose of these reefs, the design and installation, experimental goals, and some preliminary data.

Cobb, J.S., M. Clancy, and R.A. Wahle. 1999. Habitat-based assessment of lobster abundance: a case study of an oil spill. American Fisheries Society Symposium. 22:285-298.

Abstract: Benthic-phase juvenile lobsters' dependence on shelter-providing habitat not only makes possible the definition of essential habitat for lobsters but also permits the assessment of abundance based on the areal extent of habitat. Here, researchers describe such a habitat-based assessment, performed in response to an oil spill on the coast of Rhode Island. Postspill lobster density varied greatly from the impact region to the control region. The total number of lobsters in the area was calculated by overlaying contours of lobster density on a habitat map generated by side-scan sonar and then multiplying the density of lobsters in each contour interval by the area of appropriate lobster habitat (cobble and boulder) in the interval. To calculate loss, postspill abundance was subtracted from prespill abundance. The calculated loss was very sensitive to changes in prespill density estimates indicating the necessity of detailed habitat maps and accurate density estimates in habitat-based assessment of lobster population size.

Cobb, J.S., T. Gulbransen, B.F. Phillips, D. Wang, and M. Syslo. 1983. Behavior and Distribution of Larval and Early Juvenile *Homarus americanus*. Canadian Journal of Fisheries and Aquatic Sciences. 40(12):2184-2188.

Abstract: Field behavioral observations and plankton tows show that American lobster (Homarus americanus) larvae are concentrated in downwellings characteristic of shallow sea fronts. Stage IV lobsters swimming at the surface avoided floating weeds and sticks. Seventy percent of laboratory-reared fourth stage lobsters swam near the surface for more than a minute when released but only 25% of fifth stage lobsters did so. When early fourth stage lobsters encountered bottom, they did not remain long in one place, but late fourth and early fifth stage lobsters began to burrow. Late fourth and early fifth stage lobsters were less likely to return to the surface when they reached bottom. If the bottom was unsuitable (featureless sand), the lobsters resumed swimming. These behaviors appear to be an appropriate mechanism for substrate selection during settlement.

Cobb, J.S., D. Wang, and D.B. Campbell. 1989. Timing of Settlement by Postlarval Lobsters (*Homarus-americanus*): Field and Laboratory Evidence. Journal of Crustacean Biology. 9(1):60-66.

Abstract: Observations of postlarvae of the American lobster Homarus americanus in large tanks indicate that the postlarvae start to exhibit bottom-seeking behaviors, such as diving, between 2 and 6 days after molting into the postlarval (fourth) stage. This correlates well with earlier suggestions that lobster postlarvae are pelagic until about midway through the postlarval period. However, field observations of the molt stages of postlarvae caught in Block Island Sound and in Buzzards Bay in the summers of 1985-1987 indicate that they may be pelagic until quite late in the postlarval period. In addition, differences in the frequency distributions of the molt stages of field-caught animals between Buzzards Bay and Block Island Sound [USA] and among years suggest considerable flexibility in the timing of settling.

Cole, D.L. 1956. Commentary on Narragansett Bay Sediments. USL Technical Memorandum Serial No. 1105-3-56. U.S. Navy Underwater Sound Laboratory. New London, CT.

Abstract: The report presents a study of 22 cores. Samples were taken progressively at discrete intervals from top to bottom of each of these cores, a sieve analysis was done on each of these sections, and determinations of wet density, dry density, and porosity were made for most of these sections. This work yields data of considerable interest to the author and is remarkable for the range of porosities, wet densities, and dry densities involved.

Cole, T.J. 1979. Ecological Genetic Investigations of Cape Cod Populations of the Oyster Drill *Urosalpinx cinerea*. Ph.D. Thesis. Boston University Marine Program. Boston, MA.

Collier, T.K., B.F. Anulacion, and B.D. Bill. 1998. Hepatic CYP1A in Winter Flounder (*Pleuronectes americanus*) along the Northeast Coast: Results from the National Benthic Surveillance Project. Marine Pollution Bulletin. 37(1-2):86-91.

Abstract: As part of the National Benthic Surveillance Project, cytochrome P4501A (CYP1A) and associated enzyme activities were measured in more than 700 samples of liver tissue collected from adult non-spawning winter flounder (*Pleuronectes americanus*). Between 1988 and 1994, animals were sampled annually from 20 sites, ranging from Penobscot Bay in Maine to Great Bay, New Jersey. Analyses performed were assays of aryl hydrocarbon hydroxylase (AHH) and ethoxyresorufin-O-deethylase (EROD) activities, and immunoquantitation of CYP1A by enzyme-linked immunosorbent assay (ELISA). From 1988 through 1990, CYP1A was measured by all three methods, to help determine an appropriate method for assessing temporal trends and to allow for eventual comparisons to methods used in other monitoring efforts. From 1991 through 1994, assays were only done for hepatic AHH activity. Fish from virtually all sites showed induction of hepatic AHH activity, consistent with earlier reports, though fish sampled from sites in the coastal waters of Maine generally showed the lowest mean AHH activities. At sites where fish were sampled during three to six separate years (15 of the 20), individual data were analyzed for monotonic temporal trends. There were trends towards increasing AHH activities over time in fish from the Raritan Bay/Long Island Sound area, and generally increasing trends for sites near Massachusetts (especially Boston Harbor) and Rhode Island. A decreasing trend was noted in fish from Great Bay, New Jersey, and there appeared to be decreasing activities in fish from the nearshore waters of Maine, though these trends were not statistically significant at the α =0.05 level. The induction of CYP1A is strongly associated with exposure to chemical contaminants, and while the consequences of widespread and increasing induction of CYP1A are not known, these results suggest that the measurement of this enzyme system in benthic fish can be a useful tool for monitoring our coastal ecosystems.

Collins, B.P. 1974. Suspended Material Transport in Lower Narragansett Bay and Western Rhode Island Sound. University of Rhode Island. Kingston, RI .

Connolly, J.P. 1991. Application of a Food Chain Model to Polychlorinated Biphenyl Contamination of the Lobster and Winter Flounder Food Chains in New Bedford Harbor. Environmental Science & Technology. 25(4):760-770.

Abstract: PCB concentrations in Pseudopleuronectes americanus and, to a lesser extent, in Homarus americanus are derived from the sediment. Dietary uptake exceeds uptake across the gill for all 4 homologues examined and becomes the dominant route at the higher chlorinated homologues. Differences in lobster and flounder PCB concentrations appear to be due to differences in the importance of the benthic component of the food chains of these animals and differences in whole body lipid content. -from Author

Connolly, J.P. and J.P. St. John. 1988. Application of a Mathematical Food Chain Model to Evaluate Remedial Alternatives for PCB-contaminated Sediments in New Bedford Harbor, Massachusetts. Pages 359-362 In: Superfund '88: 9th National Conference and Exhibition on Hazardous Waste. Hazardous Materials Control Research Institute. Silver Spring, MD. 659 pp.

Abstract: Since the 1940s, electronics manufacturing firms in the New Bedford, Massachusetts, area have discharged PCB-laden wastewaters to the Acushnet River and New Bedford Harbor, seriously contaminating the waterways and local biota. PCB concentrations are above Food and Drug Administration action levels in many species including the lobster and portions of the area have been closed to commercial and recreational fishing and shellfish harvesting. An investigation has therefore been undertaken to identify practical actions, which may be considered to reduce the contamination problem. HydroQual participated in the development of a comprehensive field program to measure contaminants in the water column, sediment, and biota of the New Bedford area, which would be suitable for mathematical analysis. A food chain model has been constructed for contaminated top predator species: the American lobster and winter flounder. The food chain below the top predators includes mussels, clams, crabs, plankton and polychaetes. The model is used to track four PCB homologs, total PCB and three heavy metals, copper, cadmium and

lead, through the food chains for these species in response to contaminated water columns and sediments. The model was calibrated with field data collected in New Bedford Harbor and Buzzards Bay during 1984 and 1985. After calibration, the model will be used to assess future conditions under no action and with various remedial measures. 14 refs., 4 figs., 2 tabs.

Connor, M.S. 1980. Snail Grazing Effects on the Composition and Metabolism of Benthic Diatom Communities and Subsequent Effects on Fish Growth. MIT/WHOI Joint Program, Woods Hole Ocean. Institute. Woods Hole, MA.

Abstract: Eastern mud snails (Ilyanassa obsoleta) in densities of zero, six or twelve snails were placed in flow-through laboratory microcosms (765 cm²) and incubated for five weeks. Other tanks were raked daily to a depth of 10 mm. Grazing by low densities of snails significantly increased chlorophyll standing stock, respiration and gross photosynthesis as measured by light and dark exchange of oxygen and carbon dioxide compared to untreated tanks. The standing stocks of algal pigments, respiration and photosynthesis were depressed in the microcosms, which received the 12-snail, or the raking treatments. Simulating snail excretion by fertilization with ammonium increased chlorophyll standing stock by a similar magnitude, but this effect could be inhibited by raking the sediments daily. At low densities Ilyanassa's acceleration of nutrient cycling stimulates algal growth, but this effect is overwhelmed at higher densities by overgrazing and stirring inhibition.

The dominant benthic algal group in the containers were pennate diatoms. Grazed containers contained a larger percentage of the non-motile classes of diatoms, as compared to the motile forms, which predominated in the untreated microcosms. The snails are able to selectively graze these mobile species. Their gut contents are enriched in carbon, nitrogen and algal pigment content by 20-40 times over the surface sediments.

A small, non-significant, growth effect can be seen in the snails' response to density changes, but another marsh consumer, Fundulus heteroclitus, grows faster at low snail densities when snails are absent.

Connor, M.S., J.M. Teal, and I. Valiela. 1982. The Effect of Feeding by Mud Snails (*Ilyanassa obsoleta*) on the Structure and Metabolism of a Laboratory Benthic Algal Community. Journal of Experimental Marine Biology and Ecology . 65:29-45.

Abstract: Eastern mud snails, *Ilyanassa obsoleta* (Say), in densities of 1, 80, and 160 snails · m^{-2} were placed in flow-through laboratory microcosms containing 5 cm of frozen and sieved sediments. Other microcosms were raked once daily to a depth of 10 mm. All these containers were incubated for 5 wk and regularly sampled for plant pigments and light and dark transfer of oxygen and carbon dioxide. Feeding at the low density significantly increased chlorophyll standing stock. Respiration and gross photosynthesis increased by an even greater percentage compared to ungrazed controls. Standing stocks of algal pigments, respiration, and photosynthesis were depressed in microcosms, which received the 160-snail or raking treatments.

The dominant benthic algae in the containers were pennate diatoms. Grazed containers contained a larger percentage of non-motile as compared to motile forms.

Sediments fertilized with ammonium at a rate equivalent to excretion of six snails, showed increased chlorophyll content equal to the 80-snail treatment. Daily raking inhibited this effect.

We conclude that low densities of *Ilyanassa obsoleta* stimulate algal growth by accelerating nitrogen cycling and selectively removing specific components of the diatom community. At high snail densities these effects are overwhelmed by overgrazing and sediment stirring.

Conover, J.T. 1958. Seasonal Growth of Benthic Marine Plants as Related to Environmental Factors in an Estuary. Pages 97-147. Volume 5. Inst. Mar. Sci., U. Texas. TX.

Abstract: A study was made of the standing crops of 70 taxa of benthic marine plants and some physical, chemical, and biotic agents in a tidal estuary. Seasonal comparisons were made between plant growth and environmental factors from 1952 to 1954.

The standing crop of benthic marine plants was in excess of 4.0 kg. wet weight per quarter meter during July and August and less than 1.5 kg. in January. Temperature and illumination were variously associated with the maximum seasonal growth of those benthic plants studied. Some species, including *Cladophora gracilis* F. *tenuis, Enteromorpha linza,* E. *plumosa, Stilophora rhizoides,* and *Ulva lactuca* var. *latissima*, grew best under conditions of high insolation (over 500 gram calories per square centimeter per day) at moderate water temperatures (18° to 20° C.). Others, including *Agardhiella tenera, Enteromorpha compressa, Gracilaria verrucosa, Ruppa Maritima* and *Zostera marina*, showed increased growth under diminished light intensities (less than 400 gram calories per square centimeter per day) at high water temperatures (over 24° C.). The low calculated seasonal yield of one group, including *Enteromorpha clathrata, E. intestinalis, Ectocarpus siliculosus, Gracilaria verrucosa, Polysiphonia novae-angliae, Punctaria plantaginea*, and *Scytosiphon lomentaria* was related to low concentrations of inorganic phosphate (less than 0.4 microgram atoms/liter P) in the spring (April to May) and nitrate (less than 0.2 microgram atoms/liter N) in the fall (October).

Forty-seven of the 70 taxa flourished in the tidal and brackish areas of the estuary. Sixteen of the 70, including *Chondra crispus, Corallina officinalis, Enteromorpha linza, Gelidium crinale, Nemalion multifidum, Petalonia fascia, Polysiphonia nigrescens, P. novae-angliae, Punctaria plantagineae, Sargassum filipendula* and *Ulva lactuca* var. *rigida* were found only in normal sea water at the mouth of the estuary. The occurrence of some species, including *Ceramium rubrum* var. *proliferum, Ectocarpus siliculosus, Gracilaria verrucosa, Spyridia filamentosa* and *Stilophora rhizoides*, in the brackish water sloughs in January and February and their absence in low salinity water in March and April, suggested some relationship with either rising temperatures or changes in water density.

Six species of *Vaucheria*, found only in the marshland between neap and spring high water levels, were observed to fruit in winter and early spring but attained best vegetative growth in mid-summer. Fruiting periods of all six species were associated with spring tides.

A large portion of the benthic plant populations of the major basin of the estuary was observed to receive large additions of algal sporelings which first became established on coarse beach sediments and after some growth were wave-transported onto the silt-laden basin floor. These plants were still attached to small shells or pebbles. The effects of sedimentation, tidal currents, storm and hurricane winds, ice, and freezing are described. The aperiodic occurrences of some species in the area from 1952 through 1956 remain unexplained.

Cook, G.S. 1966. Non-tidal Circulation in Rhode Island Sound; Drift Bottle and Seabed Drifter Experiments (1962-1963). U.S. Naval Underwater Weapons Research and Engineering Station. Newport, RI.

Abstract: In order to aid the USN recovering torpedoes in the Rhode Island Sound and Narragansett Bay area the Naval Underwater Weapons Research and Engineering Station initiated a shallow water environment program with emphasis on both short and long term changes in the physical oceanographic environment. Results gave surface and bottom circulation patterns for various periods in the spring, summer and autumn.

Cooper, R.A. 1967. Age and Growth of the Tautog, *Tautoga onitis* (Linnaeus), from Rhode Island. Transactions of the American Fisheries Society. 96 :134-142.

Abstract: The validity of age determination from the opercular bone of the tautog (*Tautoga onitis*) is

established. An examination of the opercular bone margin over a 1-year period demonstrated that the sharp transition from translucent to opaque bone represents a year mark.

A logarithmic transformation of both fish length and length of the opercular bone was linear. Lengths at annuli were calculated by this relationship. Males grow faster than females in length (548 mm at age 22 compared with 501), but slower in weight (1,716 grams at age 20 compared with 2,094 gram for females). The eviscerated weight of male and female tautog captured in May and June increased as the 2.78 and 3.02 powers of the length. The greatest age of tautog examined was about 34 years. Growth differences among discrete spawning groups from Narragansett Bay were not significant.

Cooper, R.A. and J.R. Uzmann. 1980. Ecology of Juvenile and Adult *Homarus*. Chap. 3. Pages 97-142 In: Cobb, J.S. and B.F. Phillips, The Biology and Management of Lobsters Vol. II Ecology and Management. Academic Press, New York.

Abstract: This chapter reviews the ecology of juvenile and adult American and European lobsters. It is structured around inshore and offshore populations of *Homarus americanus*. The review of *H. gammarus* (European lobster) ecology deals primarily with the inshore lobster and the planktonic phases (stages I-!V) of the life cycle are not discussed.

Corbin, J.M. 1989. Recent and Historical Accumulation of Trace Metal Contaminants in the Sediment of Narragansett Bay, Rhode Island. Masters Thesis. University of Rhode Island, Graduate School . Narragansett, RI.

Abstract: The sediments of Narragansett Bay provide a record of historical as well as recent pollution input to the bay waters. In order to properly construct a history of metal contamination from a sediment core, it is first important to understand the present day sources and behavior of metal contaminants in the surface sediment. This approach justifies the organization of this thesis. The general chemistry, behavior and primary sources of trace metals in Narragansett Bay sediment is discussed first, and then the factors controlling the present day distribution of trace metals in the surface sediment are detailed. Combining the calculated sedimentation rates from each site with the downcore trace metal profiles allows for the construction of a historical metal contamination history for sediment from 9 different sites throughout Narragansett Bay. In addition, an attempt has been made to correct the tract metal data for both organic carbon and grain-size variations. The variation in organic carbon content between sites results in an almost negligible correction to the metals data, whereas a rather large grain-size correction is required for samples that contain large amounts of sand-size sediment.

Metal concentrations in recent surface sediment show exponential decreases with increasing distance away from the head of the Providence River. Copper has the highest concentrations with lead, chromium and cadmium following in decreasing order. Concentrations decrease along the length of the Providence River and drop substantially outside of the river mouth. This trend clearly illustrates that the upper Providence River is the dominant source of metal pollution to the bay. Several other sources outside of the river also input metals to the sediment including the Warren River, Newport Sewage Treatment Plant and the Quonset Point electroplating facility. Silver concentrations indicate that the entire upper bay sediment is contaminated relative to the lower bay. The Warren River, Mount Hope Bay and the Providence River are all contributing elevated levels of silver to the upper Bay sediment.

Sediment cores from the upper Providence River and Seekonk River reveal increasing trace metal concentrations (Cu, Pb, Cr, Ag, Cd) beginning in the early to mid 1800's. Municipal and industrial discharge are believed to be the sources of the contamination. Concentrations continue to increase to the present as a result of population and industrial growth. In general, metal contamination levels decrease downriver defining the upper Providence and Seekonk-Blackstone Rivers as the dominant sources of pollution input. Metal concentrations in the upper and mid bay do not begin increasing until the late 1800's, illustrating that the Providence area was the initial center of industrial growth. Metal profiles from Field's Point and Sabin Point illustrate that the Field's Point Waste Water Treatment Facility has had a profound effect on sediment metal contamination since 1900. Pawtuxet Cove sediment contamination

levels are higher than typical mid Providence River sediment as the result of metal input along the length of the Pawtuxet River. Metal concentrations in Pawtuxet Cove sediment show metal concentrations increasing more rapidly near 1930, corresponding to a change in the nature of the Pawtuxet River industry at that time.

Apponaug Cove, Greenwich Bay and Calf Pasture Point comprise of a suite of sites with varying metal contamination. Apponaug Cove sediment is the most contaminated as a result of the historical textile industry in the cove. Metal concentrations at all three sites begin increasing near 1870 and all the sites appear to have been effected by the pollution from the Apponaug industry. Greenwich Bay and Calf Pasture Point sediment illustrate that additional sources of pollution including domestic sewage and road runoff have affected metal levels at these sites.

Grain size, magnetic susceptibility, water content, organic carbon and x-ray photographs all indicate that the upper contaminated sediment is lithologically different from the deeper sediment. Increased population and industrial growth and the accelerated clearance of land have altered the composition of sediment entering the bay.

Sedimentation rates are highest at the head of the Providence River (Fox Point = 3.75 cm/yr) with accumulation decreasing downriver (Sabin Point = 0.32 cm/yr). Comparison of our data with previous investigations shows that sedimentation rates can vary considerably within the upper bay as the result of circulation patterns. Apponaug Cove, Greenwich Bay and Calf Pasture Point represent sedimentation rates from the mid bay. Apponaug Cove appears to be trapping sediment more effectively than Greenwich Bay (0.51 and 0.35 cm/yr respectively), and Calf Pasture Point shows the lowest sedimentation rate (0.23 cm/yr). The similarity between sedimentation rates from Calf Pasture Point and Ohio Ledge (0.23 and 0.28 cm/yr respectively) suggests that sediment accumulation in the mid bay is more uniform than in the Providence River and upper bay.

Comparison of surface sediment metal concentrations in Narragansett Bay with values from other geographic locations defines the relative sediment quality in the bay. The Seekonk River and upper Providence River show extreme levels of trace metal contamination. Copper, lead and cadmium concentrations are several times higher than levels in Boston Harbor and Long Island Sound sediment, whereas chromium and silver levels are slightly lower. Mid-Providence River sediment (Sabin Point) is less contaminated, but metal concentrations are sill similar to or higher than values in Boston Harbor and Long Island Sound. Metal contamination in the upper (Ohio Ledge) and mid bay (Calf Pasture Point) are much lower, similar to values in sediment from the Chesapeake Bay, with the exception that Ohio Ledge sediment shows rather high copper contamination.

Corey, S. 1987. Reproductive Strategies and Comparative Fecundity of *Crangon septemspinosa* Say (Decapoda, Caridea). Crustaceana. 52(1):25-28.

Abstract: Life histories of C. septemspinosa Say, have been determined and related to environmental variables in the following parts of its geographical range: Northumberland Strait, Bay of Fundy, Lamoine Maine, Mystic River, Georges Bank, Vineyard Sound and Woods Hole, Delaware Bay and Chesapeake Bay. In many areas within the range of C. septemspinosa Say, 1818 two spawning seasons are present. As no separation of fecundity data between the spring and fall spawners has been done previously, the two seasons were separated and also the volumes of various embryological stages were determined.

Cornillon, P. 1979. A Nearshore Sediment Resuspension Study in the Waters of Block Island Sound / Submitted to Yankee Atomic Electric Company, Westboro, Massachusetts. University of Rhode Island, Department of Ocean Engineering. Kingston, RI.

Abstract: The study is divided into two major sections: one dealing with roughness and bedform of the bottom and of sediment properties in the study area (Bottom/Sediment Characteristics), and the other with the dynamic properties of the sea surface and near bottom waters (Ocean Dynamics). The Bottom/Sediment Characteristics section of the project consisted of three subsections: a detailed precision

bathymetry of the study area, the deployment and monitoring of three stake fields, and a laboratory analysis of the resuspension potential of bottom sediments obtained from the stake fields. The objective of both the precision bathymetry and the stake field program was to document any changes in the thickness of the sediment deposits over a period of several months to a year. The rate of change in sediment thickness on the bottom (erosion/accretion) provides a first order estimate of the volume of sediment in suspension in the area.

Costa, J.E. 1988. Eelgrass in Buzzards Bay: Distribution, Production and Historical Changes in Abundance. Buzzards Bay Technical Report 88-05. Boston University Marine Program. Woods Hole, MA. 204 pp.

Abstract: The past and present-day distribution of eelgrass (*Zostera marina* L.) in Buzzards Bay was documented using aerial photographs, field surveys, nautical charts, sediment cores, and first-hand accounts. Today, eelgrass is a dominant habitat along the shallow margins of Buzzards Bay. Eelgrass growth correlates with local temperature and insolation, and annual production is -350 g C $m^{-2}y^{-1}$. In Buzzards Bay, eelgrass covers 41 km^2 of substrate and accounts for 11% of primary production; in small shallow bays, eelgrass beds account for 40% of all production. Equally important, these beds act as a nursery, refuge, and feeding ground for many fish, invertebrates, and waterfowl.

Crawford, R.E. and C.G. Carey. 1985. Retention of Winter Flounder Larvae within a Rhode Island Salt Pond. Estuaries. 8(2B):217-227.

Abstract: Two winter flounder, Pseudopleuronectes americanus, spawning sites in a 630-hectare Rhode Island lagoon were located by collecting eggs with a modified epibenthic sled towed by boat. A two-dimensional vertically averaged hydrodynamic model predicted that larvae hatched at these spawning sites would be minimally displaced by tidal movement. Ichthyoplankton samples taken hourly during the day at six location on March 27 and April 27, 1981 reflected the larval distribution predicted by the model. Larval retention within this lagoon appeared to be strongly influenced by the hydrodynamics of this system. It is suggested that the hydrodynamic features of lagoons are exploited in the reproductive strategies of estuarine species and that the relationship between hydrodynamics and the quality of nursery habitat must be considered before making hydraulic modifications to these systems.

Crawford, R.W. 1952. The Distribution of Oxygen in the Waters of New York Bight, Block Island Sound, and Newport Bight: Cruise STIRNI-I, July - September 1951. Cornell University. Ithaca, New York.

Abstract: The mean value for oxygen in milliliters per liter at the surface for the complete area is 5.5, and for percent saturation is 102. The general pattern of distribution of surface values for both is very similar. The steepest oxygen gradient of the area existed at the mouth of New York Harbor. Here values of 6.2 to 4.7 ml/l and 114% to 80% saturation were observed. Along the New Jersey coast outside the harbor mouth the values are, as a whole, somewhat lower than the mean values for the complete area, the range being 5.6 to 4.9 ml/l and 106% to 94% saturation. The inshore waters adjacent to the southern Long Island shore from Long Beach northeast to Montauk Point vary in oxygen content from 6.5 to 5.0 ml/l and from 124% to 94% in saturation. Low values (5.0 ml/l and 96%-94% saturation) occurred off Fire Island Inlet and at Montauk Point. In Block Island Sound the highest values (6.0 ml/l and 108% saturation) were found in the northwest portion adjacent to Fisher's Island, with lowest values occurring just to the east of Montauk Point (5.1 ml/l and 94% saturation). The Newport Bight area contained changing values throughout.

The vertical sections showing the distribution of oxygen also correspond closely. Typically, the picture seems to be one of high values from the surface downward to approximately 20 meters in depth, decreasing thereafter. This does not always hold, however, and exceptions will be pointed out.

Crowley, D.J. 1962. The Benthic Fauna and Sediment Relationships of Eastern Narragansett Bay, Rhode Island (Master's Thesis).

> **Abstract:** Sixty bottom samples were taken along representative traverses across the general trend of the passages of Eastern Narragansett Bay. Comparison of sediments was based on texture and composition of the course fraction and the percent of the fine-fraction. Benthic animals were identified and numerated from whole and fragmented shells and worm or crustacean tubes.
>
> Sediments were divided into five facies, which reflect several distinct environmental influences. Three high-energy groups of sandy sediments were recognized in constricted channels, at the Bay mouth, and along some Bay margins. Two low-energy groups of muddy sediments were defined at the mouths of the rivers where they flow into wide passages, and in sheltered coves. The Anomia-Ensis-Crepidula and Spisula-"Sand Tube" communities are found in the sandier sediments; the Mya-Melinna and Mulinia-Nucula communities are most abundant in the muddier sediments. The first two groups are dominantly infaunal and epifaunal suspension feeders while the latter two groups are infaunal deposit feeders.
>
> Sediment texture is the dominant physical factor controlling animal distribution within the Bay. Temperature, salinity, and depth of water are fairly constant throughout its extent and therefore have little effect. The benthic animals depend directly upon sediment texture for attachment and protection, and are indirectly related to the sediments for food supply. Current and wave energies modified by channel construction and shore-line configuration control the deposition of terrigenous materials brought in from the rivers as well as planktonic and detrital food supply for the animals.

Cunningham, S., M.R. Dunn, and D. Whitmarsh. 1985. Fisheries Economics: An Introduction. Mansell Pub. London.

> **Abstract:** An introduction to fisheries from an economist's perspective, intended to help educate biologists about the economics behind their field, just as there are many introductory fisheries biology books for economists. Chapters cover such topics as the notion of fish production as an economic activity, the development and application of a model of commercial fishing, the impact of technological change to fisheries, biological and economic methods of regulation, how fisheries policy is conducted in North America and Great Britain, and aquaculture.

Curley, J. R., R.P. Lawton, D.L. Chadwick, K. Reback, J.M. Hickey. 1974. A Study of the Marine Resources of the Taunton River and Mount Hope Bay Division of Marine Fisheries, Massachusetts Department of Natural Resources. 37 pp.

> **Abstract:** This report is a study of the Taunton River and Mount Hope Bay, located in the towns of Berkley, Dighton, Freetown, Somerset, Swansea and Fall River in Bristol County. Upper limits of the study area were established at the bridge in Berkley and the lowermost dam in the Assonet River. Lower limits were set at the Massachusetts - Rhode Island state boundary in Mount Hope Bay. Also included were the Lee River north to the head of tidewater and the Cole River north to Route 6 bridge. Field studies were initiated in October, 1969 and terminated in September, 1970.

Danbom, S.H. 1975. Sediment Classification by Seismic Reflectivity in Eastern Block Island Sound.

> **Abstract:** A semi-automatic, electronic system used to measure seismic reflectivity of the water-bottom sediment is devised. A 3.5-kilohertz acoustic signal is used. Eastern Block Island Sound is mapped for reflectivity using this system. A regression equation is established between reflection amplitude and water-bottom sediment mean grain size. A water-bottom Wentworth sediment classification map is obtained from reflection amplitude for eastern Block Island Sound. Comparison of this map with a previous map made by an investigator using sediment samples shows general agreement, and that considerable detail has been added by this study.

Daskalakis, K.D. and T.P. O'Connor. 1994. Inventory of Chemical Concentrations in Coastal and Estuarine Sediments. [Microform]. NOAA Technical Memorandum NOS ORCA 76. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service. Silver Spring, MD. 47 pp.

Abstract: This report describes the results of an inventory of sediment contamination undertaken by the National Status and Trends (NS&T) Program. The resulting Coastal Sediment Database (COSED) of chemical concentrations, consisting of nearly 13,600 coastal sediment samples along the continental US coast, was compiled from various electronic information systems (NOAA/NS&T, STORET, ODES, the Environmental Protection Agency (EPA) Region 4, EMAP/EC, SFTB). Data on the concentrations of over 80 analytes, including metals, pesticides, polyaromatic hydrocarbons (PAH), and polychlorinated biphenyls (PCB), and physical sample parameters were assessed relative to the NS&T "High" concentrations, which correspond to the geometric mean plus one standard deviation of all NS&T site means. The spatial distribution among all COSED sites reveals more areas with "High" concentrations along the coasts of the Northeast and Gulf of Mexico than in the Southeast or West Coasts. The greatest numbers of sites with concentrations greater than five times the "High" (5×High) were near densely populated areas in poorly flushed water bodies (harbors, intracoastal waterways, *etc.*). The most common chemicals at these "5×High" levels were metals, in decreasing frequency: Hg, Cd, Sn and Ag. Total PAH was the organic compound group most commonly found in the "5×High" range.

It is recommended that the random dataset being generated by the EMAP/EC be used to establish the areal extent of chemical concentrations. While EMAP/EC does not provide data on small spatial scales, its random sampling scheme is ideal for large scale and national assessments. Based on EMAP data, more than 90% of the corresponding coastal and estuarine areas have concentrations below "High," while "5×High" concentrations are exceeded only in a very small fraction of the area.

Davis, J.P. and R.T. Sisson. 1988. Aspects of the Biology Relating to the Fisheries Management of New England Populations of the Whelks, *Busycotypus canaliculatus* and *Busycon carica*. Journal of Shellfish Research. 7(3):453-460.

Abstract: The impact of fishing pressure on local populations of whelks, Busycotypus canaliculatus and Busycon carica , was obtained by assessing population density in 1978 and 1981 in Nantucket Sound, Massachusetts. Direct census by SCUBA transects yielded a mean population density for B. canaliculatus of 4.80 and 4.06 whelks per 1000 sq. M. in 1978 and 1981, respectively. Subsequent trapping for whelks in the same area in 1978 and 1981 yielded a mean trap catch of 16.54 and 13.88 whelks per trap, respectively. These two independent density estimates are related by a simple model relating population density (D) to trap catch (C): D = -0.28 + 0.31C; r = 0.89. Potential utilization of this model to estimate the density of B. canaliculatus based on commercial catches is discussed. Current fisheries data on fishing pressure in the southern New England region is presented for both whelks and the need for additional biological information for these snails discussed.

Day, C.G. 1960. Bottom Water Temperature on Browns Ledge off Southern Massachusetts. J. Cons. Perm. Int. Explor. Mer. 25(3):235-239.

Abstract: In the course of field-testing a continuous temperature recorder developed by David H. Frantz, Jr., and Angelo Cangiamila of the Woods Hole Oceanographic Institution, a 56-day record of bottom water temperature was obtained on Browns Ledge (41°19·8'N and 71°06·0'W) off the southern coast of Massachusetts (see Fig. 1). The location was chosen for convenience in testing, but the data prove to be of insufficient interest to warrant analysis.

DeAlteris, J., N. Perry, G. DeBlois, G. Carvalho, A. Holst, A. Ganz, M.A. Rice, and J. Willis. 1993. Research Priorities for Quahog Management: Transcripts of a Panel Discussion. Pages 97-106 In: Rice, M.A. and D. Grossman-Garber. (Eds.), Proceedings of the Second Rhode Island Shellfish Industry Conference . Narragansett, Rhode Island, August 4, 1992. Rhode Island Sea Grant Report. Narragansett, Rhode Island.

Abstract: This paper contains opening remarks by the panelists, questions asked from the audience and panelists responses, with comments from the moderator. The primary topics covered were priorities for research on hard clam (Mercenaria mercenaria) fisheries and aquaculture, resource management and stock assessment, seeding and harvest of hard clams and the establishment of depuration facilities to allow harvest and sale of Mercenaria from areas now too polluted for human consumption.

DeAlteris, J., L. Skrobe, and C. Lipsky. 1999. The Significance of Seabed Disturbance by Mobile Fishing Gear Relative to Natural Processes: A Case Study in Narragansett Bay, Rhode Island. American Fisheries Society Symposium. 22:224-237.

Abstract: Seabed disturbance by mobile bottom- fishing gear has emerged as a major concern related to the conservation of essential fish habitat. However, the seabed is also disturbed by natural physical and biological processes. The biological communities that utilize a particular habitat have adapted to that environment through natural selection, and, therefore, the impact of mobile fishing gear on the habitat structure and biological community must be scaled against the magnitude and frequency of seabed disturbance due to natural causes. Fishers operating in the mouth of Narragansett Bay, Rhode Island use trawls to harvest lobsters, squid, and finfish and dredges to harvest mussels. Side-scan sonar data indicate that evidence of bottom scarring by the fishing gear is restricted to deeper waters with a seabed composition of soft cohesive sediments. A quantitative model has been developed to compare the magnitude and frequency of natural seabed disturbance to mobile fishing gear disturbance. The application of this model on a larger scale to continental shelf waters and seabed sediment environments will allow for the identification of problematic areas relative to the degradation of essential fish habitat by mobile fishing gear.

Deaver, J.W. 1975. Aerial Oceanographic Observations, Cape Cod Massachusetts to Miami, Florida, July 1969-June 1970. Oceanographic Report No. CG 373-68. U.S. Coast Guard, Oceanographic Unit. Washington, DC. 32 pp.

Abstract: Sea surface temperatures (SST) for July 1969 to June 1970 from Cape Cod, Massachusetts to Miami, Florida were measured during Coast Guard Airborne Radiation Thermometer (ART) monthly surveys. A total of 12 airborne surveys were conducted along more than 6,800 kilometers of transects covering approximately 130,000 square kilometers of Atlantic coastal waters each month. Twelve monthly SST isothern charts are presented which were contoured from these data.

The coastal SST distribution and seasonal variation is analyzed on a time-space grid.

The thermal front associated with the Gulf Stream between Cape Hatteras, North Carolina and Miami, Florida was tracked by ART and appeared to parallel the 183-meter isobath.

Distributions of certain marine animal are presented as a function of temperature and latitude.

Dein, M.G. 1981. A Quantitative, Photogrammetric Analysis of Narragansett Bay, Rhode Island Shoreline Changes, 1938-1975.

Abstract: The shoreline of Narragansett Bay, R.I. was analyzed for erosion and accretion rates using photogrammetric techniques. Vertical aerial photographs were used to map the 1938 and 1975 shorelines. Comparative mapping of the shorelines was done utilizing a zoom-transfer scope, which enabled elimination of photographic distortion. A digital planimeter was used to make areal measurements of

erosion and accretion. The 360 km of shoreline was first mapped and divided into segments according to its composition: beach, dune, cliff, or man-made structure. These segments were then measured for changes in area. Changes in beach area were presented in conjunction with shoreline surficial composition.

Areas of high erosion and accretion rates are discussed in relation to probable causal factors, such as relative erosional resistance of beach material, wave fetch, wind characteristics, bathymetry, tidal current velocity data, and local river discharge.

Areas of greatest sediment movement during the study period were cuspate shoreforms. The greatest amounts of shoreline change not engineered by man were found at McCurry and Sandy Points, on Aquidneck Island. This change is attributed to the migration of the shoreforms and is measured at a maximum of 1.7 m/yr of erosion and accretion for McCurry Point and 1.5 m/yr and 0.6 m/yr of erosion and accretion respectively for Sandy Point. Areas of little or no erosion usually occurred in protected coves, on bedrock beaches, and at man-make engineering structures. Approximately 30% of the shoreline of the bay showed little or no erosion from 1938–1975. Average erosion for those beach areas exhibiting change was 0.3 cm/yr.

A sediment budget analysis was conducted to determine the volume of sediment eroded from and added to the shoreline and to determine what percentage of eroded sediment was redeposited along the shoreline. Values were calculated for total sediment volumes and for volume percentage of cobbles and pebble, gravel, sand and silt-sized particles. Of all the sediment eroded from the shoreline, 40% was redeposited. Sand-sized material showed the highest shoreline redeposition rate for both outwash and till shorelines. Silt-sized particles were not redeposited.

Delong, A.K., J.S. Collie, C.J. Meise, and J.C. Powell. 2001. Estimating Growth and Mortality of Juvenile Winter Flounder, *Pseudopleuronectes americanus*, with a Length-based Model. Canadian Journal of Fisheries and Aquatic Sciences. 58(11):2233-2246.

Abstract: This study quantifies the combined effects of density and environmental factors on young-of-the-year (YOY) winter flounder (Pseudopleuronectes americanus) in Narragansett Bay, Rhode Island. We used a length-based model to estimate growth and mortality rates from June to October each year from 1988 to 1998. In this model, mortality and growth rates are decreasing functions of length and there is variability in individual growth. Maximum-likelihood methods were used to fit the model to length-frequency data collected by the Rhode Island Division of Fish and Wildlife beach-seine survey in Narragansett Bay during the study years. The monthly mortality rate was density dependent and was positively related to temperature. Growth rate was negatively related to density. There was a significant decline in YOY winter flounder abundance during the period of study. The most recent year of the study, 1998, had the lowest density, lowest mortality, low summer temperature, and high growth rate. Thus, growth and mortality during the juvenile stage do not appear to be limiting the recovery of this depleted winter flounder population.

Desbonnet, A. and V. Lee. 1991. Historical Trends: Water Quality and Fisheries Narragansett Bay. P-1258. Rhode Island Sea Grant College Program. Narragansett, RI. 100 pp.

Abstract: Contents: Profile of Narragansett Bay; Bay Issues and Management Overview; The Providence and Seekonk rivers: Growth and Pollution; Trends in Water Quality in Upper Narragansett Bay: Providence and Seekonk Rivers; Trends in Lower Narragansett Bay Water Quality; Trends in Water Quality in Mount Hope Bay; Trends in Narragansett Bay Fisheries. Finfisheries: Anadromous fisheries; Migratory fisheries; Bay-Based fisheries. Shellfisheries: The oyster industry; the hard clam fishery.

Desbonnet, A. and V. Lee. 1991. Links Between Water Quality and Shellfisheries in Narragansett Bay, Rhode Island. RIU-W-90-003. In: Rice, M.A., M. Grady, and M.L. Schwartz. Proceedings of the First Rhode Island Shellfisheries Conference. Narragansett, RI, August 27, 1990.

> **Abstract:** Observed declines in the abundance and distribution of commercial shellfish species are often declared to be a result of degraded water quality conditions. A historical review of changes in commercial shellfish landings, fishing effort, species abundance and distribution, and changes in water quality in Narragansett Bay, Rhode Island, was undertaken to assess these correlations. Changes in shellfisheries within Narragansett Bay had little correlation to changes in water quality parameters from an ecological and biological perspective. For Narragansett Bay, changes in shellfish landings were more closely related to changes in harvest technology, fishing effort, economics, politics, and habitat degradation than to water quality degradation.

Deubler, E.T. and J.C. Ayers. 1953. A Winter Survey of Oxygen Distribution in Long Island Sound and Block Island Sound: Cruise STIRNI-III, January - February 1952. Cornell University. Ithaca, New York.

> **Abstract:** The data in this report were obtained during January 1952 on Cruise STIRNI-III of the project. Oxygen samples were obtained at fifty-three stations. Of these, twenty-three stations were located in Block Island Sound and thirty were in Long Island Sound. The positions of these stations as well as the locations of the vertical sections (Figures 3A through 5B) are presented in Figure 2. The four westernmost stations in Long Island Sound were occupied with respect to tidal time: at slack before ebb, and at slack before flood. This was done to determine the tidal displacement of the surface parameters, salinity, temperature, and oxygen.
>
> The modified Winkler method was used to analyze the samples for oxygen content immediately after they were obtained. The oxygen percent saturation was computed from Nalle's nomograph (1936).

Diaz, R.J. 1995. Benthic Habitat Classification of Selected Areas of Narragansett Bay and the Providence River, Rhode Island. Prepared for U.S. Army Corps of Engineers, New England Division, under contract to Normandeau Associates, Inc.

Diaz, R.J. and D.F. Boesch. 1977. Impact of Fluid Mud Dredged Material on Benthic Communities of the Tidal James River, Virginia. Technical Report D-77-45. U.S. Army Corps of Engineers, Waterways Experiment Station. 38 pp.

> **Abstract:** The unconfined open-water disposal resulting from the maintenance dredging of the Jordan Point Windmill Point channel had an acute impact on the macrobenthic community. The fluid mud produced from the disposal operation probably had both physical and physiological effects on the fauna. Responses varied by species. Insects were the most sensitive and oligochaetes the least affected. Due to the resilience and opportunistic nature of the fauna the detectable impacts lasted less than 3 months. Fluid mud produced from disposal of fine-grained dredged material has properties and effects different than natural sediments. Its low density, instability and low oxygen concentration present severe problems of support, respiration and feeding of benthic organisms.

Dickerson, D.D., D.A. Nelson, M. Wolff, and L. Manners. 1992. Summary of dredging impacts on sea turtles, Kings Bay, Georgia and Cape Canaveral, Florida. NOAA Tech. Memo. NMFS-SEFC-302. Pages 148-151 Salmon, M. and J. Wyneken. (Eds.), Proceedings of the Eleventh Annual Workshop on Sea Turtle Biology and Conservation. 195.

> **Abstract:** Five threatened and endangered species of sea turtles occur along the Gulf and Atlantic Coasts of the United States, and are potentially affected when channels are periodically maintained by hopper dredging activities. The activities of sea turtles associated with these ship channel habitats are virtually unknown. The National Marine Fisheries Service (NMFS) has determined, based on the best available information, that because of their life cycle and behavioral patterns only the loggerhead (Caretta caretta),

the green (Chelonia mydas), and the Kemp's ridley (Lepidochelys kempi) are potentially put at risk by dredging activities (Studt 1987).

Dietz, F.T., C.V. Mulholland, and W.B. Birch. 1958. A Direct Measurement of Sound Velocities in Narragansett Bay Sediments. Narragansett Marine Laboratory, University of Rhode Island. Kingston, RI.

Abstract: The speed of sound has been determined in marine sediments at two locations in Narragansett Bay. The speeds were obtained by measuring the travel times required for the sound generated by a blasting cap to travel between the shot point and a hydrophone positioned inside an iron pipe below the water-sediment interface.

A sound speed of 6.3 (10^3) ft/sec (1.9 km/sec) was determined over a path length of 96 feet in sediment 85 feet thick at approximately 71°24'19.5"W and 41°34'32"N.

An average speed of 5.0(10^3) ft/sec (1.5 km/sec) was determined over three path lengths at approximately 71°25'54"W and 41°40'45"N.

Dignes, T.W. 1977. Latest Quaternary Benthic Foraminiferal Paleoecology and Sedimentary History of Vibracores from Block Island Sound.

Donohue, J.J. 1954. Marine Sedimentation Project Annual Report, 31 August 1952 - 30 August 1953. Narragansett Marine Laboratory, University of Rhode Island. Narragansett, RI.

Abstract: The present report covers the first year's operations in the study of mine behavior. A list of the project personnel is given and a statement of the objectives of the program is made. Research accomplished and the schedule status of the period are reported on. Technical developments are discussed and a tentative schedule for future work is given.

Dorf, B.A. 1994. Ecology of Juvenile Tautog (*Tautoga onitis*) in Narragansett Bay, Rhode Island. University of Rhode Island. Kingston, RI.

Abstract: Tautog (Tautoga onitis) are a commercially and recreationally exploited temperate reef fish distributed throughout northeastern and mid-Atlantic Bight states. In Narragansett Bay, adult abundances have been decreasing with increased exploitation. Until now, little information was available on early life history characteristics of young-of-the-year (YOY) tautog in Narragansett Bay. A four-year study (1988-92) was undertaken using a 16-station beach seine survey to gather information, which could assist in making rational and informed fishery and habitat management decisions.

Juvenile abundances (0.03-8.1 fish·100 m²) were highest at northern stations and greater at stations with medium or high macroalgal or eelgrass cover than at stations with low cover. Macroalgal habitat dominated benthic cover in Narragansett Bay and was an important nursery area, although juveniles also utilized eelgrass. Juveniles from previous year classes were collected in June and YOY first appeared in July or August, declining in abundance in the following months. By October, few fish were collected, possibly due either to mortality or movement to alternative habitats. In 1991, Hurricane Bob disrupted juvenile size distribution and abundance.

Age and growth patterns were examined using otolith increment analysis. Hatch dates ranged from 23 May to 26 July. Early hatched fish did not appear in late season collections, implying variable mortality with hatch date or movement to different habitats with age. Larval duration (mean 20.3 d) and growth rates based on observed and back-calculated total length (TL) at age (0.54 mm·d^{-1}) were similar to those from southern New Jersey. Back-calculated pre-settlement growth rates (0.75 mm·d^{-1}) were higher than post-settlement rates. Size at the end of the first growth season was less in Narragansett Bay (mean 50 mm TL) than in New Jersey (75 mm standard length). A relatively short growth season in Narragansett Bay coupled with lack of growth rate compensation suggests that temperature effects may account for latitudinal

differences in TL with age.

Ontogenetic diet shifts were noted with fish size. Juveniles 20-49 mm TL consumed amphipods and copepods. Fish 50-69 mm TL comprised a generalist group. Large juveniles, 70-99 mm TL, ate decapod crustaceans.

Dorf, B.A. and J.C. Powell. 1997. Distribution, Abundance, and Habitat Characteristics of Juvenile Tautog (*Tautoga onitis*, Family Labridae) in Narragansett Bay, Rhode Island, 1988-1992. Estuaries. 20(3):589-600.

Abstract: Estuarine nursery areas are critical for successful recruitment of tautog (*Tautoga onitis*), yet they have not been studied over most of this species' range. Distribution, abundance and habitat characteristics of young-of-the-year (YOY, age 0) and age 1+ juvenile tautog were evaluated during 1988-1992 in the Narragansett Bay estuary, Rhode Island, using a 16-station, beach-seine survey. Estuary-wide abundance was similar among years. Greatest numbers of juveniles were collected at northern Narragansett Bay stations between July and September. Juvenile abundances varied with density of macroalgal and eelgrass cover; abundances ranged from 0.03 fish per 100 m² to 8.1 fish per 100 m². Although juveniles use eelgrass, macroalgae is the dominant vegetative cover in Narragansett Bay. Macroalgal habitats play a previously unrealized, important role and contribute to successful recruitment of juvenile tautog in Narragansett Bay. Juvenile abundances did not vary with sediment type or salinity, but were correlated with surface water temperature. Fish collected in June were age 1+ juveniles from the previous year-class (50-167 mm TL) and these declined in number after July or August. The appearance of YOY (25-30 mm TL) in July and August was coincident with the period of their greatest abundances. A precipitous decline in abundance occurred by October because of the individual or combined effects of mortality and movement to alternative habitats. Based on juvenile abundance, a previously unidentified spawning area was noted in Mount Hope Bay, a smaller embayment attached to the northeastern portion of Narragansett Bay. In August 1991, Hurricane Bob disrupted juvenile size distribution and abundance, resulting in reduced numbers of YOY collected after the storm and few 1+ juveniles in 1992.

Dorsey, E.M. and J. Pederson. (Eds.). 1998. Geological overview of the sea floor of New England. MIT Sea Grant Publication, 98-4. Pages 8-14 Dorsey, E.M. and J. Pederson. (Eds.), Effects of Fishing Gear on the Sea Floor of New England. Conservation Law Foundation. Boston, MA.

Dortch, M.S., L.Z. Hales, J.V. Letter, and W.H. McAnally, Jr. 1990. Methods of Determining the Long-term Fate of Dredged Material for Aquatic Disposal Sites. [Microform]. Dredging Operations Technical Support Program. U.S. Army Corps of Engineers, Environmental Laboratory. Vicksburg, Miss.

Abstract: To manage an open-water dredged material disposal site, it is essential to know the physical capacity of the site (*i.e.*, how much material should be dumped at the site and what the capability is of the material to remain onsite under various environmental conditions of waves and currents). Long-term management of aquatic disposal sites also requires an understanding of how much area the disposal mound encompasses, when the mound encroaches on the site boundaries, how much material leaves the site, and perhaps where the material ultimately goes.

The purpose of this report is to identify methods that can be used to develop information concerning the long-term fate of dredged material disposed at aquatic sites. The methods are broken into two major categories: (a) methods of analysis for mound resuspension and dynamics and (b) methods of analysis for transport and redeposition of mound material. For each of these two categories, four basic approaches are reviewed: (a) steady-state analytical methods; (b) time- and rate-dependent analytical methods; (c) physical and numerical modeling; and (d) measurements through field and laboratory studies.

Other sections of the report are devoted to discussions of physical processes and study recommendations. Additional details of the methods of analysis are provided in four appendixes.

Driscoll, E.G. 1974. Oxygen, Salinity, pH, and Temperature Variations in the Bottom Water of Buzzards Bay. Biological Bulletin. 143(2):459.

> **Abstract:** Hydrographic parameters immediately adjacent to the bottom at four stations in northern Buzzards Bay, Massachusetts, have been monitored monthly from October 1971 to August 1972. Water samples were hand pumped into BOD bottles by divers. Collection apparatus consisted of two 30-cm² boards separated by a 1 cm distance. Rubber tubing, and an associated rubber bulb with a one-way valve, extends from the center of one board surface to the BOD bottle. The collection apparatus rests on the bottom during pumping and draws water gently from immediately above the sediment-water interface, between the two boards, and into the sample bottle. Samples for dissolved oxygen determination were "fixed" with manganous sulfate and alkaline iodide reagents on the bottom. Oxygen values obtained by this technique differ by as much as 0.15 mg/l from values obtained 0.5 m above the sediment-water interface.
>
> Bottom temperatures in Buzzards Bay range from –0.5° C to 27° C in shallow marginal areas and from 0° C to 22° C in the central area. Dissolved oxygen in the bottom water ranges from 12.2 mg/l in February to 4.3 mg/l in July and is less over mud and muddy sand bottoms throughout most of the year. Dissolved oxygen is also reduced at least 3 mg/l in marginal areas which become frozen over. Salinity ranges from 28‰ to 33‰, and pH from 7.5 to 8.1, throughout the year. The highest June rainfall in forty-eight years resulted in salinity reductions in excess of 2‰ in marginal areas and 1‰ in central portions of the bay.
>
> Annual mean dissolved oxygen and pH values of the bottom water correlate with the mean grain diameter of the substratum, presumably a reflection of the organic content of the sediment.

Driscoll, E.G. 1968. Shelly Substrates, Clionids and the Abundance of Attached Epifauna. Geol. Soc. Am. Spec. Paper 115. Pages 385-386.

Driscoll, E.G. 1968. Sublittoral Attached Epifaunal Development in Buzzards Bay, Massachusetts, USA. Hydrobiologia . 32(1/2):27-32.

> **Abstract:** The present study was undertaken in order to examine epifaunal development under natural conditions in Buzzards Bay, Massachusetts. Considerable research concerning epifaunal attachment and growth on test panels and artificial objects has previously been published. Many of these articles have been summarized by Woods Hole Oceanographic Institution (1952). Less attention has been directed to sublittoral epifaunal communities under natural conditions. The present study includes observations on size, orientation, and substratum preference of certain species of pelecypods, bryozoans, gastropods, annelids, and barnacles. The approximate relative abundance of each form during 1965–1966 is also given.

Driscoll, E.G. and D.E. Brandon. 1973. Mollusc-Sediment Relationships in Northwestern Buzzards Bay, Massachusetts, USA. Malacologia. 12(1):13-46.

> **Abstract:** Four facies are defined in the recent sediments of the northwestern part of Buzzards Bay, Massachusetts. These are characterized by differences in mean grain diameter, sorting, silt-clay content and fauna. A mean grain diameter of less than 2.5 (0.18 mm) is characteristic of three of these facies, which are found in protected areas. The fourth, developing on current-swept bottoms, typically is composed of coarser sediments. Calcium carbonate content of the sediment is a reflection of dead shell abundance throughout the area.
>
> Faunas of the 3 fine-grained facies are characterized respectively by (1) *Nucula proxima*, (2) *Yoldia limaturla* and *Nassarium trivittatus* and (3) *Macoma tenta, Nucul proxima, Eupleura caudate* and *Nassarrius trivittatus*. No more than 8 species compose 1% or more of the molluscan fauna in any of the 3 fine-grained facies. In the coarser sediments of the 4th facies 11 species comprise in excess of 1% of the mollusks. Dominant species in this facies are *Nassarium trivittatus, Anachis avara simili, Chaetopleura apiculata, Anadara transversa* and *Crepidula fornicata*.

The distribution of more than 35 molluscan species is discussed . The majority have hard parts which are potentially preservable. Mean grain diameter, abundance of silt and clay, and presence of dead shells are important factors in mollusc distribution. *Macoma tenta, Yoldia limatula, Nucula proxima and Soleyma velum* increase in abundance with decreasing mean grain diameter and increasing silt-clay content of the sediment. *Chaetopleura apiculata, Anadara transversa, Crasinella mactracea* and many other species increase in abundance with increasing mean grain diameter and decreasing silt-clay content of the sediment. Greater abundance and diversity of epifaunal species is found on bottoms having higher concentrations of dead shells.

Potential faunal-lithic associations, indicate that suspension feeding bivalves and carnivorous gastropods are available for preservation in the coarse grained facies. Potential fossils of the proto-graywacke, which makes up the 3 fine-grained facies, are mostly deposit feeding bivalves.

Driscoll, E.G. and R.A. Swanson. 1973. Diversity and Structure of Epifaunal Communities on Mollusc Valves, Buzzards Bay, Massachusetts. Palaeogeography, Palaeoclimatology, Palaeoecology. 14(3):229-247.

Abstract: The diversity, homogeneity and population structure of epifauna living on dead bivalve shells in a shallow marine bay are examined. Twenty-eight shells of *Mercenaria mercenaria* were artificially emplaced on each of three different sediment types in Buzzards Bay, Massachusetts, for one year. Living faunas (53,000 individuals assignable to 106 species) and preservable faunas (16,000 individuals assignable to 25 species), which colonized these shells, are compared.

Living epifaunas demonstrate a moderately good fit to the Preston truncated lognormal distribution but deviate consistently from the MacArthur broken-stick model. Homogeneity and diversity of living faunas are greater on shells resting on coarse sediments. The rarefaction methodology overestimates faunal diversity in both living and preservable faunas.

Preservable epifaunas possess a higher homogeneity but one which is generally parallel to that of the living communities from which they are derived. The diversity of preservable epifaunas does not reflect the diversity of the living faunas from which they are derived.

Abundant species living on shells are more likely to possess preservable hard parts than are rare species. This is indicative of the evolutionary success of various protective devices in epibenthic communities exposed to predation and environmental vagaries.

Driscoll, J.N. 1975. Transient Structure in Benthic Communities. The Effects of Oxygen Stress, Burial, and High Rates of Sedimentation. Ph.D. Thesis . MIT/WHOI Joint Program, Woods Hole Ocean. Inst. Woods Hole, MA.

Driscoll N. 1996. Scientists Study Large Storm and Human Effects in Block Island Sound . Oceanus 39:22.

Abstract: Analysis of the Block Island Sound data indicates that large storm systems have had little effect on large-scale morphology and sedimentary bedforms. One explanation for this surprising observation is that the submerged portion of the Ronkonkoma glacial moraine that extends from the eastern tip of Long Island to Block Island and continues northward toward Point Judith, Rhode Island, acts as a natural jetty at the mouth of Block Island Sound, dissipating much of the storms' wave energy. The shallowest portions of the submerged moraine are 8 to 10 meters deep, whereas the study area is shoreward of this shoal in 30 to 50 meter water depths. Much of Block Island Sound is in the lee of both the subaerial and submerged portions of the glacial moraine and thus protected from large, storm-induced waves. Consequently, the glacial morphology imparted by the Laurentide ice sheets almost 18,000 years ago still influences present-day sediment transport, erosion, and deposition in Block Island Sound.

Driscoll, N.W. 1996. Side-scan Sonar Investigation of Shallow-water Depositional Processes in and Around Block Island Sound: Before and After the Nor'easter of 1992. United States. 26 pp.

Abstract: Using side-scan and sub-bottom sonar, we surveyed portions of Block Island Sound before and after the occurrence of a number of large storms to determine how storm events modify the distribution and type of bedforms, sedimentary facies, and acoustic backscatter of shelf sediments. Our analysis of the data suggest that the passage of these large storms did not significantly modify the existing sedimentary bedforms or the large-scale acoustic backscatter patterns observed in Block Island Sound. Correlation of sub-bottom and side-scan sonar data in conjunction with surficial sediment type indicates that the physiography and subsurface geology generated during the last glaciation and deglaciation strongly influences the present-day sediment transport, erosion, and deposition in Block Island Sound. Although there are no significant large-scale changes observed between 1991 and 1994, numerous smaller-scale changes are observed.

Duerr, C. 1981. Dredge Spoil Dumping Becomes a Tiny State's Giant Problem. Sea Grant Today 11:6-9, March/April 1981.

Duncan, T.K. 1980. An Analysis of the Biological Rhythms of Marine Benthic Crustaceans. Volume M.S. Thesis. Southern Massachusetts University . North Dartmouth, MA.

Duncan, T.K. 1980. Life History and Ecology of *Almyracuma proximoculi* (Crustacean Cumacea). Ph.D. Thesis. Boston, University. Boston, MA.

Abstract: The estuarine cumacean *Almyracuma proximoculi* is found year-round, predominantly in the uppermost centimeter of sediment, in the immediate vicinity of intertidal freshwater springs in the northeastern United States. These areas are inhabited by a typical estuarine peracarid crustacean fauna, and this species is the numerically dominant peracarid in this habitat, with typical densities ranging from 2, 00 5000/m2. The combination of small annual temperature changes and large semidiurnal salinity fluctuations make these areas unusual intertidal habitats. Laboratory studies of this species' tolerance of salinity/temperature combinations involving salinities ranging from distilled water to 32 o/oo and temperatures from 0° to 20° C indicate high survival rates at combinations involving salinities of 0.25 o/oo or greater and temperatures of 10° C or less. Its low survival rates at 20° C probably explain its inability to become established in other local, more typical estuarine habitats, which usually exceed this temperature in summer.

Each of two intensively studied populations of *A. proximoculi* synchronously produce two generations per year. The following developmental stages occur: first manca, second manca, juvenile, juvenile male, mature male, juvenile female, preparatory female, marsupial female, and intermediate female. There are minor differences in life history parameters between populations and major differences between generations. Compared to the overwintering generations the summer generations have more rapid within-marsupium and post-marsupium developmental rates, have lower fecundity, are shorter-lived , and produce smaller adults. These differences are apparently due to the influence of ambient temperature.

A. proximoculi is the least sexually dimorphic cumacean known, due to the progenetic condition of the male. The most distinct sexually dimorphic characters present in the male are the greater spination of the urpods and the greater thickness and the length of the abdomen, uropods, third maxilipeds, and the first pereopods. These all facilitate the rapid removal of the female's exuvia during the fertilization molt. The typical combination of male cumacean morphological characters, which facilitates motility and chemoreception, is not present in *A. proximoculi*. These characters are maladaptive for an infaunal existence and are apparently unnecessary in this species, which lives in dense, intertidal populations

Durbin, A.G. and E.G. Durbin. 1998. Effects of Menhaden Predation on Plankton Populations in Narragansett Bay, Rhode Island. Estuaries. 21(3):449-465.

Abstract: The Atlantic menhaden, *Brevoortia tyrannus*, is an abundant plankton-feeding fish that undertakes extensive seasonal migrations, moving from overwintering locations offshore south of Cape Hatteras to the mid-Atlantic Bight and New England inshore waters during spring and summer. A bioenergetic model, based on field and laboratory studies, shows that when large numbers of menhaden enter Narragansett Bay, Rhode Island, during spring and early summer, they significantly influence plankton populations through size-selective grazing and nutrient regeneration. A population biomass of 9.1 x 10^6 kg of menhaden feeding for 12 h each day in the upper bay would result in a substantial reduction of the instantaneous growth rate of the >20-μm phytoplankton. Instantaneous growth rates of zooplankton would be negative if the same population of menhaden was present, resulting in a reduction in the biomass of zooplankton. Given the ambient phytoplankton and zooplankton populations, menhaden could achieve the seasonal growth measured in Narragansett Bay during 1976 by feeding on average about 5 h d^{-1}. Daily nitrogen excretion rates of the 9.1 x 10^6 kg menhaden population were 56.4% of the mean standing stock of ammonia-N in the upper bay. Because menhaden travel in schools their effects are likely to be intense but strongly localized, increasing spatial heterogeneity in the ecosystem. When the fish migrate southward in the fall they transfer between 3.3% and 6.2% of the nitrogen exported annually from the bay.

Durbin, A.G. and E.G. Durbin. 1988. Zooplankton and Ichthyoplankton in Narragansett Bay: Status and Trends Part 1: Zooplankton. Prepared for: The New England Interstate Water Pollution control Commission. The Narragansett Bay Project is sponsored by the U.S. EPA and the RI DEM.

Durbin, A. G., E.G. Durbin. 1990. Zooplankton and Ichthyoplankton in Narragansett Bay: Status and Trends Part 2: Ichthyoplankton. Prepared for: The New England Interstate Water Pollution Control Commission. The Narragansett Bay Project is sponsored by the U.S. EPA and the RI DEM

Abstract: There have been three major studies of fish eggs and larvae in Narragansett and Mt. Hope Bays: a study at 4 stations during 1957-1958 (Herman 1958, 1963); a study of 160 stations during 1972-73 by Marine Research, Inc. (1974) and a monitoring program since 1972 in Mt. Hope Bay, also by MRI (1972-86).

In the 1972-73 study a total of 42 species or species groups of fish eggs and larvae were found; maximum abundance was during June-July and minimum abundance during September-January. The rank order of the more abundant species was: anchovies, menhaden, winter flounder, tautog, cunner, sand launce, weakfish, windowpane, silversides, mackerel, seaboard goby, and fourbeard rockling. Two species (sand launce and winter flounder) are winter-spring spawners, with peak abundance of larvae during April; two (fourbeard rockling and mackerel) are late spring-early summer spawners with larval peaks in May-June; and 7 are late spring-early summer spawners with peak abundance of larvae in June-July (bay anchovy, tautog, cunner, silversides, weakfish, windowpane, and seaboard goby). Atlantic menhaden have a protracted spawning season with greatest intensity during spring and fall. The more abundant species could be classified into three groups according to their centers of abundance: 8 of the 12 most abundant species (menhaden, anchovy, winter flounder, tautog, weakfish, windowpane, silversides, and seaboard goby) were most abundant in the upper Narragansett/Mt. Hope Bays; 3 species (sand launce, rockling, and mackerel) were most abundant in the lower East Passage; while 1 species, the cunner, seems to be abundant in both the upper and lower bay. Thus the uppermost, most environmentally impacted areas of Narragansett and Mt. Hope Bays also provide the major spawning/nursery areas for most of the locally abundant fish species.

Herman (1958) identified 34 taxa of fish larvae in his 1957-58 study, all of which were also subsequently found in the 1972-73 study by MRI. However the rank order of the most abundant species was quite different in the two studies; in Herman's study the 12 most abundant species were: sculpin, silversides, cunner, anchovy, scup, sand launce, searobin, butterfish, winter flounder, tautog, northern pipefish, and radiated shanny. Thus a list of the 12 most abundant larval fish species in both studies had only 6 species in common. The difference in rank order appeared to be due primarily to differences in the relative abundance of 5 species (winter flounder, silversides, goby, sand launce, and sculpin), which hatch from

demersal eggs. Thus the relative abundance of these species as larvae could not be independently confirmed from the data on pelagic eggs. It was unclear whether the differences in the rank order of species in the two studies were due to biased data reflecting differences in sampling fear, or real differences in the fish community.

The long-term study by MRI in Mt. Hope Bay has revealed that the total population of larvae has exhibited about 3-fold variation in number, with evidence of a 4-5 year periodicity, between 1972-86. However the variation in the number of individual species has been much larger than this. The most striking change since 1972 has been a 1000-fold decline in the number of Atlantic menhaden and its replacement by anchovies, predominantly bay anchovy, as the numerical dominant in the system.

Durso, V., T. Rioux, D. Shea, J. Sparrow, and S. Youngblood. 1979. An Inventory of Quahogs and Soft Shell Clams Available to the Recreational Fisherman, Town of Bourne. Northeast Marine Environment Institute.

Earthlink. 1997. Energy/Communications Cable Links Nantucket to Mainland. Electrical World. 211(6):24.

Abstract: In late 1996, the island of Nantucket, off the coast of Cape Cod, Mass., became a little less isolated when power began flowing through a power and communications cable linking the island to the mainland. The 29-mi submarine and land-cable system is Nantucket's first physical connection to the mainland of any kind and the longest submarine power cable in the Northeast (Fig 1). The $34-million project replaces seven old diesel generators.

The issues of most concern included the landfalls–both in sensitive beach and summer tourist environments; disruption to the seabed during installation; and avoidance of major construction and disruption at both Harwich and Nantucket during the tourist season.

Eddie, G.C. 1983. Engineering, Economics and Fisheries Management. Fishing News Books Ltd. Farnham, England. 106 pp.

Abstract: An analysis of the relationship between engineering, economics, and fisheries management. Author recognizes that in fisheries management, many aspects are easily overlooked because of their familiarity and that there are economic and practical constraints on technical development, which are not fully appreciated. He outlines the historical background and gives specific examples from his experience. This book is essential for all who are involved in managing, planning, or developing a commercial fishery in any country of the world, vessel owners, fishing skippers *etc.*

Ellis, G.E. Surface Waves and Dynamic Bottom Pressure at Buzzards Bay, Massachusetts. Report No. DRL, A292. 65 pp.

Elner, R.W. and S.L. Hamet. 1984. The Effects of Ocean Dumping of Dredge Spoils onto Juvenile Lobster Habitat: A Field Evaluation. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1247. Fisheries Research Board of Canada. 12 pp.

Abstract: Two hundred cubic meters of noncontaminated sand-silt-clay sediment were dumped onto a presurveyed juvenile American lobster, Homarus americanus, habitat in Halifax Harbor, Nova Scotia. SCUBA divers carried out five surveys of lobsters and crabs on the dump, the adjacent hard bottom, and on a control area over a 12-mo period. In addition, the divers charted the extensive changes in the topography of the dumped sediment and monitored the invasion of macrofauna and macroflora. Both lobster and crab densities on the dumped sediment remained low, relative to the adjacent hard bottom and the control area, over the postdumping monitoring period. The few macrofaunal and macrofloral species invading the dump appeared either sedentary and constrained to settlement on exposed boulders above the spoil, or errant species. We hypothesize that dumping can adversely affect lobsters and crabs by decreasing shelter and

prey availability and, thus, increasing inter- and intraspecific competition.

Elskus, A.A., R. Pruell, and J.J. Stegeman. 1992. Endogenously-mediated, Pretranslational Suppression of Cytochrome P4501A in PCB-contaminated Flounder. Marine Environmental Research. 34(1-4):97-101.

Abstract: Gonadally mature fish display strong sex-related differences in the content and activity of P4501A, the major polynuclear aromatic hydrocarbon-inducible P450 form in teleosts. Such differences appear related to plasma levels of the female sex steroid, estradiol (E sub(2)); however, neither the mechanism of estradiol suppression of P4501A nor the capacity for hormonal regulation to overcome P4501A induction by high concentrations of potent inducers are known. Gonadally mature flounder (Pseudopleuronectes americanus) were collected from Fox Island (FI), Rhode Island, a reference site, and New Bedford Harbor (NB), Massachusetts, a site highly contaminated with polychlorinated biphenyls (PCBs). Differences in flounder P4501A catalytic activity (measured as ethoxyresorufin-O-deethylase, EROD), P4501A protein content (immunoquantitated), and P4501A mRNA content (by Northern blot) as they relate to sex, reproductive status, and hepatic PCB content. Our results confirm that suppression of P4501A in gonadally mature female fish is probably due, at least in part, to elevated E sub(2) titers, and demonstrate that such suppression occurs at a pretranslational level and, further, that endogenous regulation of P4501A expression can 'override' exogenous regulation by even high concentrations of P4501A inducers.

Elskus, A.A., J.J. Stegeman, J.W. Gooch, D.E. Black, and R.J. Pruell. 1994. Polychlorinated Biphenyl Congener Distributions in Winter Flounder as Related to Gender, Spawning Site, and Congener Metabolism. Environmental Science and Technology. 28(3):401-407.

Abstract: Concentrations of 17 polychlorinated biphenyl (PCB) congeners were measured in liver of gonadally mature winter flounder collected from Fox Island and Gaspee Point, RI, and from New Bedford Harbor, MA. These locations represent spawning sites with different degrees and sources of PCB contamination. The data demonstrate that the PCB concentrations and patterns in these fish reflect those of their spawning grounds, indicating that winter flounder caught in clean offshore waters could have substantial amounts of tissue PCB, that the content of PCB congeners in winter flounder liver is influenced little by sex or reproductive condition, and that flounder selectively metabolize PCB congeners with adjacent meta, para-unsubstituted carbon atoms. Based on congener concentrations and 2,3,7,8-tetrachlorodibenzo-*p*-dioxin equivalency factors, the non-ortho congeners, 77, 126, and 169, contributed more to the potential (mammalian) toxicity of PCB in flounder than more abundant, but less toxic, non-coplanar congeners.

Ely, E. and D.T. Crist. 2000. Narragansett Bay Window: The Cooperative Bay Program Phase 1. RIU-G-01-002. Rhode Island Sea Grant, University of Rhode Island. Narragansett, RI. 16 pp.

Abstract: A federal grant was awarded to fund the Cooperative Bay Program, which was launched in 1998 and is being managed cooperatively by the National Oceanic and Atmospheric Administration, the National Marine Fisheries Service, and the R.I. Department of Environmental Management. The Cooperative Bay Program has been nicknamed the 'Bay Window' because it will provide a brand-new view of Narragansett Bay. The data collected by the project will help researchers look for answers to a wide variety of questions, such as: How healthy is Narragansett Bay? Is pollution increasing or decreasing? Are fisheries management strategies working? Is the Bay getting warmer? Are dissolved oxygen levels adequate for Bay creatures? For its success, the Bay Window program relies on two key ingredients: state-of-the-art technology and scientific collaboration. Here, the program is briefly described.

Emerson, D.J. 1982. The Monitoring of *Clostridium perfringens* Spore Density in Bottom Sediments and its Applications. URI.

Abstract: *Clostridium perfringens* is an anaerobic, spore-forming bacterium that is consistently associated

with human fecal wastes. Two extraction-separation procedures were developed for use in conjunction with the mCP membrane filtration method for the enumeration of *C. perfringens* spores in bottom sediments. In the simpler of the two procedures a distilled water suspension of the sediment sample is pulse sonicated for 10 seconds and allowed to settle. Portions of the supernatant are removed and assayed by the mCP membrane filtration method. This procedure is recommended for general usage. A more complicated procedure using a two-phase separation system was also developed for use in situations where the presence of "toxic" materials are suspected or where relatively low spore densities are present in fine silts. The recoveries of *C. perfringens* spores by the two procedures, when used in conjunction with the mCP method, were comparable to each other and significantly greater than those by the British most-probable-number (MPN) method. It was estimated that over 85 percent of the spores were recovered by the procedures. The precision of the "sonicate-and-settle" - mCP method, as determined from the coefficients of variation for paired assays on 87 sediment samples was markedly better than that theoretically obtained by the MPN method and approached that theoretically attributable to counting an average of 85 colonies on each of two plates.

Monitoring the sediments underlying coastal and estuarine waters for the spores of *C. perfringens* could provide rather sensitive data on the long-term trends in the deposition and movement of sewage sludge. Furthermore, the comparison of *C. perfringens* spore densities to those of the less "hardy" indicators, the fecal streptococci and coliforms, could provide information on the nature and proximity of fecal inputs to aquatic environments. Another possible application would be its use as a "naturally occurring" conservative tracer to examine the *in situ* biological decay of fecal pathogens and indicator bacteria. Some of these ideas were explored using *C. perfringens* density data obtained from analysis by the extraction-separation methods of sediment samples from two locations, Narragansett Bay, Rhode Island and the New York Bight. The *C. perfringens* spore densities in Narragansett Bay sediments were highest in the upper reaches of the Providence River near the major sources of municipal sewage discharges into the bay and decreased with increasing distance from these sources. The highest *C. perfringens* densities in the New York Bight were found in sediment samples collected from the deeper waters to the west and southwest of the dumpsite. The limited data available suggest little movement of the sludge shoreward to the north and west beyond the 20-meter contour line.

Emery, K.O. and E. Uchupi. 1972. Western North Atlantic Ocean: Topography, Rocks, Structure, Water, Life, and Sediments. Memoir 17. The American Association of Petroleum Geologists. Tulsa, OK.

Abstract: Table of Contents received: (1) Exploration; (2) Physiography; (3) Rocks; (4) Structure; (5) Water; (6) Life; (7) Sediments; (8) Origin of Continental Margin

Engen, S. 1978. Stochastic Abundance Models, with Emphasis on Biological Communities and Species Diversity. Chapman and Hall. London .

Ericson, D.B. and H.C. Stetson. 1946. Survey of Oceanographic Conditions in Vineyard Sound and Buzzards Bay Restricted for U.S. Naval Mine Test Facilities, October and November, 1945. Woods Hole Oceanographic Institute Technical Report No WHOI-46-34. Woods Hole, MA. 57 pp.

Estrella, B.T. 1984. Black Gill and Shell Disease in American Lobster (*Homarus americanus*) as Indicators of Pollution in Massachusetts Bay and Buzzards Bay, Massachusetts. Massachusetts Division of Marine Fisheries. 21 pp.

Abstract: The incidence of "black gill" and shell disease in American lobster (*Homarus americanus*) from 12 coastal Massachusetts sites was investigated. "Black gill" and shell disease tends were similar with the highest mean incidence observed in Massachusetts Bay and Buzzards Bay. Municipal and industrial wastes are implicated in conjunction with environmental conditions, which enhance turbidity and bacterial growth.

Disease symptoms were not uniformly distributed throughout the lobster length range. Incidence was highest in the larger size groups indicating a possible inverse relationship with molt frequency. No

significant differences in the diseases' incidence were observed between the sexes.

Estrella, B.T. 1983. Massachusetts Coastal Commercial Lobster Trap Sampling Program, May-November 1981. Massachusetts Division of Marine Fisheries. 80 pp.

Abstract: A long-term American lobster (Homarus americanus) catch/effort and biological monitoring program was initiated in Massachusetts's coastal waters in 1981. With the aid of cooperating commercial lobstermen, a total of 12,392 lobster were sampled from 5,735 trap hauls. Sampling regions were chosen for coverage of major lobstering regions of the state. Statewide catch per trap haul per set-over-day in number of lobsters was 0.689 for all sizes and 0.215 for legal lobster. Catch rates were highest in the Beverly-Salem region and lowest in the outer Cape Cod region. Catch per unit effort of wire traps was significantly greater than wooden traps, with flounder yielding significantly greater catches than other baits. Lobster averaged smallest in the Buzzards Bay region, 77.6 mm, and largest in the outer Cape Cod region, 94.7 mm. Females generally outnumbered and averaged significantly smaller than males. Exploitation rates remain very high, E = 0.88 to 0.96, with the exception of the outer Cape Cod region, E = 0.45. A north-south gradient was apparent in the percent of legal females and sublegal females ovigerous, with highest incidence occurring Buzzards Bay. The percent of females ovigerous was significantly higher for lobster ≥ 81 mm. Tentative estimates of size at 100% maturity are 80-85 mm in Buzzards Bay, 90-94 mm in Cape Cod Bay, and 100-104 mm in the outer Cape Cod region. Buzzards Bay exhibited the highest percentage of new-shelled lobster indicating a faster growth rate than other regions. The statewide cull rate was 11.3%, ranging from 5.6 % in outer Cape Cod to 14.6% in Buzzards Bay; data indicate a relationship with fishing pressure. Incidence of shell disease and trap mortality was < 1%.

Estrella, B.T. 1985. Massachusetts Coastal Commercial Lobster Trap Sampling Program, May-November 1983. Massachusetts Division of Marine Fisheries.

Abstract: The third consecutive American lobster (Homarus americanus) catch/effort and biological monitoring program was completed in Massachusetts's coastal waters in 1983. Five lobstering regions were sampled monthly, during the major lobstering season, May–November. With the cooperation of coastal commercial lobstermen, a total of 17,820 lobster were sampled from 8,761 trap hauls during fifty-three trips aboard commercial lobster vessels in 1983.

The 1983 coastwide mean catch per trap haul-set-over-day indices for all lobster, legal, and sublegal size groups were 0.813, 0.278, and 0.536, respectively. These indices increased from 1982 by 17%, 11%, and 21%, respectively. This increasing abundance trend was evident during the 1981–1983 study period. Estimates of exploitation and total annual mortality were high, but remained relatively static. The coastwide mean carapace lengths were stable at approximately 82 mm, 90 mm, and 76 mm for all lobster, legal and sublegal size groups, respectively. The percentage of females ovigerous increased from 8.5 in 1981 and 13.3 in 1982 to 18.9 in 1983. Females continued to outnumber males in most cross tabulations by approximately 1.5:1. The coastwide cull rate for all lobster sampled during 1983 was 10.7% consistent with previous survey indices. Trap mortality remained low at less than one percent over the three-year period.

Estrella, B.T. 1986. Massachusetts Coastal Commercial Lobster Trap Sampling Program, May-November 1984. Massachusetts Division of Marine Fisheries.

Abstract: The fourth consecutive American lobster (Homarus americanus) catch/effort and biological monitoring program was completed in Massachusetts's coastal waters in 1984. Six lobstering regions were sampled monthly, during the major lobstering season, May–November. With the cooperation of coastal commercial lobstermen, a total of 16,513 lobster were sampled from 9,138 trap hauls during fifty-three trips aboard commercial lobster vessels.

The 1984 coastwide mean catch per trap haul-set-over-day indices for all lobster, legal, and sublegal size groups were 0.638, 0.219 and 0.418, respectively. These indices decreased from 1983 by 22%, 21% and 22%, respectively. Catch per trap haul index trends were similar but declined by only 14%. Estimates of

exploitation and total annual mortality remained high. Over 90% of the lobster landed in inshore regions were new recruits (42% east of Cape Cod). The coastwide mean carapace lengths were static at approximately 82 mm, 90 mm, and 76 mm for all lobster, legal, and sublegal size groups, respectively. A weight–length relationship was developed and a significant difference was found between the slopes of male and female regression lines. Males weighed more than females at sizes ≥ 97 mm. The percentage of females ovigerous was 9.1%, which declined 1.8% from 1983. Thirty-eight percent of all lobster sampled during 1984 were males compared to 41% during 1983. The percentage of culls increased to 14.8% from a relatively stable 10-11% during the 1981–1983 period. Trap mortality remained at less than one percent.

Estrella, B.T. 1981. Recent Molting of Lobsters Anomalous in Massachusetts. Coastal Oceanography and Climatology News. 3(4):41-42.

Abstract: In the autumn of 1980, the Massachusetts Division of Marine Fisheries received reports from commercial lobstermen of unusually late catches of "soft" or newly molted American lobsters. These observations represented a deviation from the normal autumn-spring molt synchronization. It is possible that unusually warm fall temperatures may have delayed the molt period and the rapid onset of cold temperatures may have prolonged molting and subsequent hardening of lobsters. Reduced metabolic rate and nutritional intake may also be factors, since it has been demonstrated that laboratory-raised lobsters, prevented from consuming their cast shells after molting, exhibited delayed shell hardening.

Estrella, B.T. 1991. Shell Disease in American Lobster (*Homarus americanus*, H. Milne Edwards, 1837) from Massachusetts Coastal Waters with Considerations for Standardizing Sampling. Pages 483-488. Volume 10.

Abstract: Shell disease in the American lobster (*Homarus americanus*) from six coastal Massachusetts sites was investigated. A total 4,791 lobster was collected via a commercial lobster sea sampling program during May through November, 1989. The effect of a number of variables on shell disease prevalence was evaluated in order to standardize assessments of the condition.

Disease signs were not uniformly distributed throughout the length range of the samples. Prevalence was highest and severity greatest in the large size groups indicating an inverse relationship with molt frequency. The correlation was significant for hard-shelled lobster but not for new-shelled lobster. Significant differences in disease prevalence were observed between the sexes. This was primarily due to the high level of disease observed among ovigerous females. However, mature non-ovigerous females also exhibited a significantly greater frequency of disease signs than males.

These factors are important considerations in comparative analyses. Samples used in trend studies should be standardized according to size, sex, ovigerous and molt condition, and severity.

Estrella, B.T. and S.X. Cadrin. 1995. Fecundity of the American Lobster (*Homarus americanus*) in Massachusetts Coastal Waters. ICES Marine Science Symposia. 199:61-72|.

Abstract: Fecundity estimates were calculated for American lobster (Homarus americanus) from three Massachusetts coastal regions. Southern Gulf of Maine (Cape Ann to Cape Cod Bay) estimates were significantly lower than those observed in both Buzzards Bay and outer Cape Cod. No difference was found between fecundity estimates from the latter two areas. Egg diameter was largest off outer Cape Cod followed by southern Gulf of Maine, then Buzzards Bay. Buzzards Bay females had a greater abdominal width than those from the other sites. Lobster fecundity estimates from southern Massachusetts's waters were almost identical to 100-year-old estimates from the same area. However, these historical fecundity data were significantly different from our southern Gulf of Maine estimates. An evaluation of the broad variability in published fecundity estimates for American lobster indicated that small sample sizes in some studies may have substantially affected the slopes and predictive reliability of the regression analyses. However, geographic variation is not discounted.

Estrella, B.T. and R.P. Glenn. 1999. Massachusetts Coastal Commercial Lobster Trap Sampling Program May - November, 1998. Massachusetts Division of Marine Fisheries. 20 pp.

Abstract: This is the Massachusetts Division of Marine Fisheries eighteenth annual assessment of the status of the American lobster resource in Massachusetts's coastal waters. During the period of May through November, 1998, seventy-eight (78) sampling trips were made aboard commercial lobster vessels. A total of 35,568 lobster was sampled from 15,858 trap hauls. The catch rate of marketable lobster, 0.662 lobster per trap, was 15% lower than the 1997 index, 0.776. The proportion of females ovigerous, 16.4%, was higher than in the previous year (14.7%). The coastwide fishing mortality estimate, 1.36, was similar to the 1997 index of 1.33. Exploitation rate, 0.67, mean carapace length of marketable lobster, 88.9 mm, and mean egg size of egg-bearing females, 86.4 mm, dropped only fractionally. The cull rate, 20.9%, was similar to the 1997 estimate of 20.4%. Less than 1% of the lobster sampled from traps were dead.

An index of pre-recruit abundance was created using data from our sea sampling database. The catch rate of lobster in the pre-recruit size class provided the basis of the index. The index was calculated from a multiple regression of log transformed catch rates with the following factors: month, year, lobsterman. The back-transformed regression coefficient associated with the factor "year," adjusted for the effects of the other analyzed factors, provided the index of pre-recruit abundance. The relationship between the index and Massachusetts territorial waters catch in the following year was modeled using a power function. The resulting equation was used to calculate predicted landings, which differed from the actual landings for the years 1981-1998 by 0.34 to 27.6% with a mean difference of 7.27%.

A time series of data from our bottom water temperature monitoring program is presented for seven locations in Buzzards Bay, Cape Cod, and Massachusetts Bay.

Estrella, B.T. and R.P. Glenn. 2000. Massachusetts Coastal Commercial Lobster Trap Sampling Program May - November, 1999. Massachusetts Division of Marine Fisheries.

Abstract: This is the American Division of Marine Fisheries nineteenth annual assessment of the status of the American lobster resource in Massachusetts's coastal waters. During the period of May through November, 1999, seventy-nine (79) sampling trips were made aboard commercial lobster vessels. A total of 31,637 lobster was sampled from 15,102 trap hauls. The catch rate of marketable lobster, 0.902 lobster per trap, was 36% higher than the 1998 index, 0.662. The proportion of females ovigerous, 17,4%, was higher than in the previous year (16.4%). The coastwide fishing mortality estimate, 1.22, was lower than the 1998 index of 1.36. Exploitation rate, 0.67, remained unchanged, while mean carapace length of marketable lobster, 89.6 mm, and mean size of egg-bearing females, 88.1 mm, increased fractionally. The cull rate, 20.8%, was similar to the 1998 estimate of 20.9%. Less than 1% of the lobster sampled from traps were dead.

An index of pre-recruit abundance was created using data from our sea sampling database. The catch rate of lobster in the pre-recruit size class provided the basis of the index. The index was calculated from a multiple regression of log transformed catch rates with the following factors: month, year, lobsterman. The back-transformed regression coefficient associated with the factor "year," adjusted for the effects of the other analyzed factors, provided the index of pre-recruit abundance. The relationship between the index and Massachusetts territorial waters catch in the following year was modeled using a power function. The resulting equation was used to calculate predicted landings, which differed from the actual landings for the years 1981-1999 by 0.43 to 25.54% with a mean difference of 8.65%.

A time series of data from our bottom water temperature monitoring program is presented for seven locations in Buzzards Bay, Cape Cod Bay, and Massachusetts Bay.

Estrella, B.T. and R.P. Glenn. 2001. Massachusetts Coastal Commercial Lobster Trap Sampling Program May - November, 2000. Massachusetts Division of Marine Fisheries.

Abstract: This is the Massachusetts Division of Marine Fisheries twentieth annual assessment of the status of the American lobster resource in Massachusetts's coastal waters. During the period of May through November, 2000, eighty-three (83) sampling trips were made aboard commercial lobster vessels. A total of

38,390 lobster was sampled from 17,251 trap hauls. The catch rate of marketable lobster, 0.885 lobster per trap, was 2% lower than the 1999 index, 0.902. The proportion of females ovigerous, 15.4%, was lower than in the previous year (17.4%). The coastwide fishing mortality estimate, 1.38, was higher than the 1999 index of 1.22. Exploitation rate, 0.68, increased fractionally, while mean carapace length of marketable lobster, 89.4 mm, and mean size of egg-bearing females, 88.1 mm, were similar and remained unchanged, respectively. The cull rate, 18.2%, decreased about 2% from the 1999 estimate of 20.8%. Less than 1% of the lobster sampled from traps were dead.

A time series of data from our bottom water temperature monitoring program is presented for seven locations in Buzzards Bay, Cape Cod Bay, and Massachusetts Bay for the period 1985 –2000. The locations of three shallow water sites (<20'), added during summer 2000, are depicted.

Estrella, B.T. and D.J. McKiernan. 1989. Catch-per-unit-effort and Biological Parameters from the Massachusetts Coastal Lobster (*Homarus americanus*) Resource: Description and Trends. National Oceanographic and Atmospheric Association Technical Report National Marine Fisheries Service 81. 21 pp.

Abstract: A comprehensive description of the Massachusetts coastal lobster (Homarus americanus) resource was obtained by sampling commercial catches coastwide at sea and at dealerships between 1981 and 1986. A commercial lobster sea-sampling program, wherein six coastal regions were sampled monthly, with an areal and temporal data weighting design, was the primary source of data.

An improved index of catch per trap haul/set-over-day was generated by modeling the relationship between catch and immersion time and standardizing effort. This 6-year time-series of mean annual catch rates tracked closely the landings trend of territorial waters.

During the study period there was a gradual increase in indices of exploitation and total annual mortality, which corresponded to a gradual decline in mean carapace length of marketable lobster. The frequency of cull escalated from 10.0% in 1981 to 20.9% in 1986, while the percentage of lobster found dead in traps was consistently less than 1%. The sex ration (%F:%M) was significantly different from 50:50 and approximated a 60:40 relationship during the study period.

Male and female weight-length relationships were significantly different. Females weighted more than males at smaller sizes and less than males at larger sizes. A north-south clinal trend was evident wherein lobster north of Cape Cod weighed less at length than those from regions south of Cape Cod.

Functional size-maturity relationships were developed for female lobster by staging cement gland development. Proportions mature at size represent more realistic values than those obtained by analysis of percent of females ovigerous.

Regional variation occurred in most of the parameters studied. Three lobster groups, differing in major population descriptors, are defined by our data.

Estrella, B.T. and T.D. Morrissey. 1997. Seasonal Movement of Offshore American Lobster, *Homarus americanus*, Tagged along the Eastern Shore of Cape Cod, Massachusetts. Pages 466-476. Volume 95.

Abstract: A total of 1,237 tagged American lobsters, *Homarus americanus*, with a carapace length (CL) range of 48 to 198 mm (mean CL of 104 mm) were liberated at three release stations off the eastern shore of Cape Cod, MA, between 1969 and 1971. By 1973, 332 (26.8%) of the tags were returned. Mean time at large was 112.5 days (range 0–897 d).

One hundred and thirty (39.2%) of the recaptured lobsters moved less than 10 km from their points of release. One hundred and fifty-one (45.5%) were recaptured within 10 to 40 km from their points of release; 51 (15.4%) at 40 km or more.

Recapture depths and distances traveled were significantly greater in colder months. The distribution of these recaptures with time, depth, and location indicates seasonal movement to and from the edge of the continental shelf between fall and spring.

The apparent reshoaling of these inshore-tagged lobsters to the eastern shore of Massachusetts in successive summers and the greater movement shown by females with ripe eggs at tagging, versus the movement of sublegal and nonovigerous female classes, suggest that the migration of this group of offshore lobsters is stimulated by seasonal changes in environmental cues in relation to hatching or reproductive needs (or both). Their relation to the Georges Bank–Southern Offshore stock unit, reproductive potential, and extensive seasonal movement into the southern and western Gulf of Maine, represent important considerations for resource managers and emphasize the need for further research on rate of stock interchange.

Estrella, B.T. and J.B. O'Gorman. 1983. Massachusetts Coastal Commercial Lobster Trap Sampling Program, May-November 1982. Massachusetts Division of Marine Fisheries. 103 pp.

Abstract: The second consecutive American lobster Homarus americanus) catch/effort and biological monitoring program was completed in Massachusetts coastal waters in 1982. With the aid of cooperating commercial lobstermen, a total of 12,760 lobster were sampled from 6,150 trap hauls. Five sampling regions were chosen for coverage of major lobstering regions of the state. Statewide catch per trap haul per set-over-day in number of lobster for all sizes was 0.650, , slightly lower than the 1981 index of 0.689. The sublegal catch rate, 0.400, was lower than that of the previous year, 0.462; however, the legal lobster catch rate, 0.232, was elevated from the 1981 rate of 0.215. Mean length, 81.6 mm, was significantly larger than the 1981 mean, 80.4 mm. Sex ratio, 40/60 (M/F); percent of females ovigerous, 6.9%; cull rate, 10.5%; molt frequency, 1.3%; shell disease < 1%; and trap mortality, < 1%, were not significantly different from 1981 calculations. Total instantaneous mortality rates were highest in Buzzards Bay and lowest in the outer Cape Cod region. Size at first maturity and 100 maturity were found to occur at 70–74 mm and 95–99 mm, respectively, in Gulf of Maine regions; 80–84 mm and 100–104 mm, respectively, in the outer Cape Cod region; and 60–64 mm and 75–79 mm, respectively, in Buzzards Bay. Cape Cod Bay and Buzzards Bay female lobster exhibited significantly wider carapace widths than males, while no difference between sexes was found for outer Cape Cod lobster. Sex ratios from dimorphic regions exhibited fewer males. Analyses of sex ratios by set-over-day and from concurrent otter trawl catches support the existence of an escapement differential for sublegal males from populations exhibiting a sexually dimorphic carapace width.

Farrington, J.W. 1986. Coastal Research Center Report of the Period May 1984 - February 1986.Technical Report. WHOI-86/16; CRC-86/2. United States. 62p.

Abstract: The Coastal Research Center activities for the period of 1984 to 1986 are described briefly. Major projects include: Assimilative Capacity-Buzzards Bay, Georges Bank book; Instrumentation-Experimental Seawater flume, Sea level change - measurement and consequences; and Fisheries ecology. General activities are also described.

Feigenbaum, D. 1982. Feeding by the Chaetognath, *Sagitta elegans,* at Low Temperatures in Vineyard Sound, Massachusetts, USA. Limnology and Oceanography. 27(4):699-706.

Abstract: Feeding rates were determined for *S. elegans* feeding in Vineyard Sound, Massachusetts, at a temperature of 0°C by applying a digestion time (10.2 h), obtained from laboratory observations, to an analysis of gut contents. The specific daily ration of large individuals was about 1–2% of body dry wt·d^{-1}, that of small chaetognaths (3.5 mm) was about 46%. Feeding rates for all but the smallest animals are similar to those predicted from respiration data; the smallest individuals consumed more than their estimated no-growth requirements.

Feld, S. and N. Rorholm. 1973. Economic Growth and the Generation of Waterborne Wastes. Marine Technical Report No 12. University of Rhode Island. Kingston, RI.

Abstract: The primary objective of this study is to demonstrate how to quantify the interaction among economic activities and water effluent loadings for the area surrounding Narragansett Bay, Rhode Island. A second objective is to discuss some uses of an economic waste generation model in public decision-making.

The study focuses on economic activity and its waterborne residuals within the Narragansett Bay Drainage Basin. This region accounts for over 90 percent of the economic activity of Rhode Island and slightly less than 10 percent of that of Massachusetts.

These basis for the study are an input-output framework for the area's economy disaggregated into 59 endogenous sectors and 4 exogenous final-demand sectors, and a matrix of effluent coefficients and water usage coefficients for the endogenous sector. The effluent data were obtained primarily from permit applications submitted by Rhode Island firms to the U.S. Army Corps of Engineers. Some were from appropriate industries studied in other regions of the country (1,2,3). The economic model was constructed by updating, expanding and resectoring an earlier input-output model of the greater metropolitan Providence area (4).

The study concludes that much as the multiplier effects caused by economic interdependencies are of critical importance in regional economic development, so are the waste products generated by these interdependencies of substantial importance to the regional ecology. Upon reflection, it is not surprising that this should be so. However, recognition of these "waste multipliers" seems even less widespread in local and state economic development circles than is the general recognition of the pervasive role played by economic interdependencies. The policy implication is that the cost savings in pollution control or, conversely, the abatement effect of a given public outlay may be significantly increased by selective rather than by broad controls. These gains or savings to society may be great enough to overcome the political difficulties associated with selective controls.

Fell, P.E., R.S. Warren, and W.A. Niering. 2000. Restoration of Salt and Brackish Tidelands in Southern New England: Angiosperms, Macroinvertebrates, Fish, and Birds. Pages 845-858 In: Weinstein, M.P. and D.A. Kreeger, (Eds.), Concepts and Controversies in Tidal Marsh Ecology. Kluwer Academic Publishers, Dordrecht, Boston & London.

Abstract: Tidal restriction, dredge spoil deposition, and other fill activities have converted about 2000 ha of Connecticut's tidal salt marshes to non-tidal or microtidal systems vegetated by near monocultures of Phragmites *australis* or *Typha angustifolia*. In addition, *Phragmites* is also expanding in certain undisturbed brackish tidelands, replacing the typical tidal marsh angiosperms. Returning normal tidal hydrology to formerly restricted polyhaline (18 to 30 o/oo) and euhaline 30 to 35 o/oo) marshes results over time in re-establishment of typical *Spartina*-dominated marsh vegetation and associated macroinvertebrate populations. Vegetation and invertebrates, along with full use of these systems by estuarine fish and salt marsh dependent birds, are collectedly considered high level integrators of multiple, complex, interacting tidal marsh functions. These various attributes return at different rates , and full functional equivalence relative to undisturbed marshes may require decades. Excavating dredged spoil filled sites to low marsh elevations and restoring tidal action allows natural repopulation by marsh angiosperms and invertebrates. Within the first year these open sites support seedling populations of *Spartina alterniflora* and annuals such *as Salicornia europaea*. Within five years *Spartina alterniflora* dominates and annuals are rare. Initial invertebrate colonizers are those with planktonic larvae, such as *Melampus bidentatus, Geukensia demissa* and *Uca* spp. Invasion of brackish tidelands at the mouth of the Connecticut River by *Phragmites* appears to have little effect on macroinvertebrate populations or fish use. The vegetation of such *Phragmites*-dominated tidal wetlands can be restored, at least temporarily, by a combination of herbicide and mowing treatments.

Ferreira, R. 1980. An Analysis of the Biological Rhythms of Maine Benthic Crustaceans. M.S. Thesis. Southern Massachusetts University. North Dartmouth, MA. 110 pp.

Fofonoff, P. 1995. Distribution and Seasonal Abundance of Benthic Invertebrate Larvae in Narragansett Bay. In: Grassle, J.P., A. Kelsey, E. Oates, and P.V. Snelgrove. (Eds.), Twenty-Third Benthic Ecology Meeting. New Brunswick, NJ, March 17, 1995-March 19, 1995. Various pages.

> **Abstract:** During a two-year survey of plankton dynamics in Narragansett Bay, Rhode Island, in 1985-1987, meroplankton were sampled with a metered 153 mu m mesh net, towed obliquely. Three taxa comprised 71% of the larvae collected: Crepidula sp., Polydora sp., and Semibalanus balanoides. Polydora larvae were present year-round and most abundant in the eutrophic Providence River sub-estuary during April-July. Crepidula sp. veligers were found in May-November, and most abundant at the mouth of the River S. balanoides nauplii and cyprids occurred only from December-March, and were most abundant in the lower Bay. Seasonal and spatial patterns of these and other larvae will be related to temperature, phytoplankton abundance, and adult population distributions. A "brown-tide" bloom of Aureococcus anophageffens may have contributed to lower larval abundances in the summer of 1985 compared with 1986.

Fogarty, M.J. 1979. Assessment of the Ocean Quahog, *Arctica islandica*, Resource in Rhode Island Sound and South of Martha's Vineyard, MA. Rhode Island Department of Environmental Management, Division of Fisheries and Wildlife.

> **Abstract:** Due to the historical importance of the ocean quahog fishery to Rhode Island and the lack of detailed information on the distribution of Arctica in the southern New England region, a sampling program was undertaken by the Rhode Island Division of Fish and Wildlife to assess distribution and abundance of this species with respect to depth and substrate type. This investigation was undertaken in cooperation with the National Marine Fisheries Service under the Southern New England Fisheries Development Program.

Fogarty, M.J. 1981. Distribution and Relative Abundance of the Ocean Quahog *Arctica islandica* in Rhode Island Sound and off Martha's Vineyard, Massachusetts. Journal of Shellfish Research. 1(1):33-39.

> **Abstract:** Estimates of minimum biomass (total wet weight and meat weight) were derived for *Arctica islandica* in parts of southern New England. Total harvestable biomass for the survey area was estimated at 1.004×10^6 metric tons (mt) total wet weight, and 1.33×10^5 mt meat weight. Stepwise linear discriminant analysis was used to isolate sediment components, which contribute to separation of regions of high- and low-ocean quahog densities (arbitrarily assigned values of > 0.75 kg/m^2 and < 0.10 kg/m^2 total wet weight, respectively). The percentage of four sediment fractions: gravel, coarse sand, medium sand, silt/clay, and the percentage of shell in the sample were sufficient to significantly ($P<0.01$) discriminate between the two levels of ocean quahog densities. Size composition data and shell length-meat weight regressions for three depth intervals within the survey area are presented.

Fogarty, M.J. 1980. Movements of Tagged American Lobster off Rhode Island. Fishery Bulletin 78: 771-780.

Fox, M.F., D.R. Kester, J.E. Andrews, A. Magnuson, and C.G. Zoski. 2000. Seasonal Warming of Narragansett Bay and Rhode Island Sound in 1997: Advanced Very High Resolution Radiometer Sea Surface Temperature and In situ Measurements. Journal of Geophysical Research. 105(C9):22,071-22,082.

> **Abstract:** The warming of Narragansett Bay and the offshore waters of Rhode Island Sound (RIS) and Buzzards Bay in the spring and early summer of 1997 was studied using in situ time series data and remotely sensed advanced very high resolution radiometer sea surface temperature (SST) satellite images.

High-resolution SST images of the New England area were expanded to highlight Narragansett Bay and RIS. To validate this procedure, the remotely sensed data were compared to in situ data at the NOAA buoy in Buzzards Bay and at a spar buoy in mid-Narragansett Bay. The standard error (1.3° C) observed at the buoy in Narragansett Bay was slightly higher than that observed at the buoy in Buzzards Bay (1.0° C). A transect line down Narragansett Bay and into RIS and another across the entrance of Narragansett Bay and Buzzards Bay were extracted from the 47 images. A thermal front was observed at the mouth of the bay with the bay being warmer in the summer and cooler in the winter than the sound. Two areas of cold water were identified in the RIS transect: a cold water plume at the tip of Long Island and a second area near the Elizabeth Islands. We believe that both were caused by vertical mixing. There were three sources of in situ time series data to compare with the SST: (1) a spar buoy with sensors in the surface and bottom waters located near the middle of the Bay, (2) observations from a shore site near the mouth of the Bay, and (3) a National Oceanic and Atmospheric Administration buoy at the mouth of Buzzards Bay. Using the spar buoy data, we were able to calculate the vertical density gradient, and we found that salinity was more important than temperature in controlling the density structure at this site. Time series temperature data from the surface water in Buzzards Bay were almost identical to those observed in the bottom waters of Narragansett Bay, indicating that bottom water in the bay originates as surface water in RIS. Using a cooling event in the surface waters at the end of July, a transport time of similar to 4 days was calculated for the offshore surface waters to reach the bottom at the mid-bay location.

French, D., H. Rines, J. Boothroyd, C. Galagan, M. Harlin, A. Keller, G. Klein-MacPhee, S. Pratt, M. Gould, M. Villalard-Bohnsack, L. Gould, L. Steere, and S. Porter. 1992. Final Report: Habitat Inventory/Resource Mapping for Narragansett Bay and Associated Coastline. Volumes I- Chapters 1-4, Atlas and Maps. Report to Narragansett Bay Project, Providence, RI. Applied Science Associates, Inc.

Abstract: This report compiled and synthesized existing resource and habitat data for the area in and around Narragansett Bay. The resource and habitat inventory covers Narragansett Bay tidal waters, coastal features, adjacent lands extending 200 feet inland of the coastal features, and critical inland habitats contiguous with coastal features and/or the 200 ft buffer zone. The inventory includes geological characteristics (bathymetry, sediment type, coastal features, and erosional and depositional areas), mapping of coastal and subtidal; habitats (terrestrial, wetland, intertidal;, and subtidal), locations of critical habitats, and distributions of biological resources. Biological resources include plant and animal species of special concern, molluscan and crustacean shellfish, finfish and wildlife (waterfowl, seabirds, wading birds, shorebirds, raptors, and harbor seals).

Frey, R.W., J.D. Howard, and J. Doerjes. 1989. Coastal Sediments and Patterns of Bioturbation, Eastern Buzzards Bay, Massachusetts. Journal of Sedimentary Petrology. 59(6):1022-1035.

Abstract: Coastal sequences of eastern Buzzards Bay exhibit characteristic suites of physical and biogenic sedimentary structures related to energy gradients, geomorphology, and distributions of palimpsest glacial debris. In beach-to-offshore sequences, unbioturbated planar- to ripple-laminated or cross-bedded pebbly sands of the foreshore and shoreface give way abruptly to thoroughly bioturbated, poorly sorted sediments of the offshore zone. Preserved biogenic sedimentary structures first appear at water depths of 1 to 2 m (below MLW) and bioturbation of sediments is complete at depths of 2 to 4 m offshore. Collectively, bay-marsh sequences are reminiscent of, albeit at a much smaller scale than, estuarine sequences of the Georgia Bight.

Frisbie, C.M. 1967. Age and Growth of the Striped Bass, *Roccus saxatilis* (Walbaum) in Massachusetts Coastal Waters. University of Massachusetts. Amherst, MA. 65 pp.

Abstract: Scale samples from 1055 angled striped bass were aged and prior growth backcalculated. Random samples from 1956-1959 were studied to establish recent growth rates and to compare these with better known populations. Generally, growth rates for Massachusetts fish were comparable to those of more southern and west coast populations. Greater annual growth occurred within the second year of life as opposed to the third year maximum found in an earlier study of Connecticut fish.

Covariance analysis indicated no significant differences in length-weight relationships for the four years studied. A greater weight and length at any given age was found for Massachusetts striped bass when compared to recent California and Maryland studies. Large fish exhibited considerable variation in both length and weight. No management changes seem necessary based on the results of this study.

Fuiman, L.A. 1993. American Fisheries Society Symposium, Vol 14. Water Quality and the Early Life Stages of Fishes. In: Fuiman, L.A. (Ed.), American Fisheries Society Symposium. Kingston, RI, June 16, 1992-June 20, 1992. American Fisheries Society. Bethesda, MD. 172 pp.

Abstract: The critical importance of the early life stages of fishes, defined here as embryos, larvae, and early juveniles, to fish population dynamics has long been recognized by both fishery biologists and environmental scientists. Larvae in particular have been shown to be extremely sensitive to biological and physical fluctuations in the environment (resulting in variable recruitment) and to anthropogenic inputs to the environment (based on laboratory toxicity tests). The early life stages of fishes suffer a variety of adverse interactions with humans, ranging from exposure to toxic chemicals and habitat degradation to power-plant entrainment. In addition, overfishing of stocks can reduce the numbers of reproducing adults.

Given the international interest in environmental quality and the specific interests of the membership of the American Fisheries Society Early Life History Section, we the organizers of the 16th Annual Larval Fish Conference chose "Environmental Quality and the Early Life Stages of Fishes" as the conference theme. The conference was divided into three major areas: Problem Identification (9 papers presented), Research Approaches (24 papers), and Mitigation/Management Approaches (7 papers). This volume represents a selection of those presentations, all of which have passed a rigorous peer-review process.

Gaines, S.D. and M.D. Bertness. 1992. Dispersal of Juveniles and Variable Recruitment in Sessile Marine Species. Nature. 360:579-580.

Abstract: Marine species commonly have broadly dispersing juveniles called larvae. Their return to the adult populations is highly variable, often generating large fluctuations in population size, yet the causes of the variation are poorly understood. Historically, attention has been focused on the roles of variable reproductive output by adults and variable mortality during larval development. The limited success of these factors as general explanations prompted a more recent focus on the influence of variable transport of the larvae. Here we show that nearly a decade of settlement variation of the barnacle, *Semibalanus balanoides* (L.), closely matched predictions based solely on a transport hypothesis: differences in transport generate recruitment variation by determining whether larvae complete development near a favorable habitat. The irregular nature of coastlines, particularly the presence of bays and estuaries, generates substantial regional variation in coastal transport that may generate correspondingly large variation in recruitment to marine populations.

Gallagher, J. and A. Nalwalk. 1971. Bathymetry of Block Island Sound. Technical Memorandum No. TA131-136-71. Naval Underwater Systems Center. Newport, RI.

Abstract: The general bathymetry of Block Island Sound is quite well known. However, insufficient knowledge of the detailed distribution of small scale features, the time varying features, and the influence of navigational inaccuracies precludes a completely accurate description of the Sound's bathymetry.

The area of study comprises two physiographic provinces, *i.e.*, the Embayed Section of the Coastal Plain and the Upland Section of the New England Province (1). The bathymetry of Block Island Sound is due, largely, to a history of uplift and erosion during the Tertiary Period, continental glacial erosion and deposition processes during the Pleistocene epoch, and subsequent submergence.

The geographical description of Block Island Sound as described by Williams (2) will be briefly summarized here. Block Island Sound is a partially closed body of water with an area of about 525 square miles. Block Island Sound separates Fisher's Island, N.Y.; Montauk Point, N.Y.; and Block Island, R.I.

The adjacent water bodies are Long Island Sound to the west, Rhode Island Sound to the east, Fisher's Island Sound to the north, and the Atlantic Ocean to the south.

This description of the bathymetry of Block Island Sound, particularly the BIFI Shallow Water Acoustic Propagation Ranges, is the first in a series of planned memoranda describing the geology of the Sound. Subsequent memoranda will discuss distribution of physical and acoustic properties of the unconsolidated sediments, mineralogical distribution, sediment thickness and basement rock topography.

Ganz, A., N. Lazar, and A. Valliere. 1994. Quahog Management Project, Phase I, Greenwich Bay. Rhode Island Division of Fish and Wildlife, Coastal Fisheries Laboratory. Wakefield. RI . 67 pp.

Abstract: Throughout history, Greenwich Bay has been the center of shellfishing within Narragansett Bay, Rhode Island. It is a sheltered estuary fed by four major tributaries, (Greenwich, Apponaug, Brush Neck and Warwick Coves) and many small brooks. The bay is an ideal shellfishing ground for many reasons. It is shallow and protected from inclement winds, allowing for easy harvesting. Nutrients, water circulation, and substrate composition are favorable for growth and survival of shellfish.

Given its economic natural resource importance, water quality influences and conflicting uses, Greenwich Bay management has become a central issue in the overall resource management of the Narragansett Bay quahog fishery. The Narragansett Bay Project (NBP) Comprehensive Conservation Management Plan (CCMP) has identified the hard shell clam as a priority for development of a species-specific management plan and classified stages for achieving the proposed objectives. The objectives of Phase I of the project were: 1) to equip a vessel (Dyer 29) suitable for sampling quahog populations in Narragansett Bay; 2) to develop procedures, techniques and competencies in estimating population structure and density of quahogs in Greenwich Bay to be used as a prototype which will be expandable and applicable to the entirety of Narragansett Bay; 3) to determine the current status of fishing pressure in the Bay using catch and effort information supplied by quahoggers through field intercepts; and 4) to develop recommendations for management of the shellfishery in Greenwich Bay when the area is recertified for harvesting.

Ganz, A., A. Valliere, M. Gibson, and N. Lazar. 1999. Narragansett Bay Quahaug Management Plan. Coastal Fisheries Laboratory. Wakefield, RI. 159 pp.

Abstract: The Narragansett Bay Quahaug Management Project was funded by the Narragansett Bay Project in 1993 to provide the status of the quahaug stock in Narragansett Bay and prepare a long-term Management Plan based on current survey data and historical catch and effort data. Specific jobs of this project were comprised of five elements;

1. A twenty-nine foot research vessel was retrofitted to be used as a dredge boat for shellfish resource surveys and monitoring. The efficiency of the hydraulic dredge used for the surveys was determined by diving exercises.
2. A sampling plan was developed to conduct an initial baseline resource assessment of shellfish grounds of Narragansett Bay. This job included a comprehensive survey in Greenwich Bay for establishing guidelines for collecting catch dependent data.
3. Shellfish surveys were conducted throughout Narragansett Bay and a database was established. Since 1997, Spring and Fall surveys were conducted as a follow-up and these surveys will continue to document trends and changes in order to effectively address resource management issues as they arise.
4. A Shellfish landing data base was established.
5. A stock assessment was made and recommendations for management of the shellfishery are presented.

Shellfish surveys have been conducted in Greenwich Bay, Upper Narragansett Bay Areas A&B, West Passage, Upper East Passage, Mount Hope Bay, Kickamuit River, Sakonnet River and the Providence River. Follow-up surveys have been carried out by re-sampling twenty percent of the initial stations each spring and fall.

The baywide stock assessment indicated that the quahaug biomass is currently at a low level and below the

level needed to produce the maximum sustainable yield. This is coupled with a period of overfishing above the maximum sustainable level (Gibson, 1999). This stock decline seemed to be correlated with a documented increase in benthic invertebrate predators suggesting that stock productivity has declined.

Size composition, stock density and fishing effort varies greatly from area to area within the Bay. Although an initial goal of this project was to standardize management throughout the Bay as a unit, area specific management measures will be required in order to adequately control the fishing effort. Fishing mortality is highest in the Upper Bay and lowest in the deeper parts of the West Passage and Sakonnet River. The heavily fished areas contained a wide range of quahaug sizes and area of low fishing effort were composed of sparse densities of large sized clams.

Polluted areas of Narragansett Bay provide a natural refugia for replenishing certain areas such as the Upper Bay and Greenwich Bay. Stock transplantation can be used to establish strategically placed spawning refugia in critical areas of the Bay. It is recommended that daily catch limit be reduced statewide, and existing limits be maintained in specified shellfish management areas. Stock enhancement in target areas be encouraged by designation of spawner sanctuaries. A rotational system of opening and closures be implemented for operation of the sanctuaries. The recently initiated dealer reporting system should be further refined to integrate with the A.S.M.F.C. Atlantic Coastal Cooperative Statistics Program. Several additional management initiatives for future consideration are presented including a license moratorium, stricter penalties for shellfish violations, gear modification, and predator control.

Ganz, A.R. 1993. The Shellfish Resources of Rhode Island. Draft. Rhode Island Division of Fish and Wildlife, Coastal Fisheries Laboratory. Wakefield. RI . 45 pp.

Ganz, A.R. 1991. Survey of the Oyster Resource in the Vicinity of Sabin Point, East Providence, RI. Rhode Island Division of Fish and Wildlife, Coastal Fisheries Laboratory. Wakefield. RI .

Abstract: This report will describe the status of the economically important shellfish species in the vicinity of Sabin Point, East Providence, Rhode Island. This project was conducted in response to citizen reports of an abundance of oysters (Crassostrea virginica) in that area, selected as a site for the proposed cross bay pipeline. Although this project was originally designed to document the oyster beds in the area, preliminary investigations revealed an abundance of quahaugs (Mercenaria mercenaria) at the site, and the study was modified to document the density and size composition of both species.

Field investigations were conducted using several methods. The abundance of oysters in shallow waters was determined by counting oysters found within standard one meter square sample quadrats [sic]. Oyster and quahaug populations in deeper waters were surveyed similarly with the assistance of SCUBA divers. A commercial shellfisherman also used his bullrakes to determine the quantity of shellfish available to traditional, non-standardized methods of harvest.

Gardiner, A.H. 1915. Wrecks Around Nantucket. Reynolds Printing Inc. New Bedford, Mass. 176.

Abstract: The island of Nantucket is situated some thirty miles southeast of the Massachusetts, is fifteen miles in length, with an average breadth of four or five, and presents a coast line of about seventy-five miles. Owing to the peculiar shape of the island, and the indentures made by the harbor, the coast line, especially on the northern side, is exceedingly irregular. A light sandy beach extends around the island, and with the exception of a small reef in Muskeget Channel and a few isolated ones in the immediate vicinity of the shore on the north side of the island and Tuckernuck, the coast is entirely clear of rocks. But equally to be dreaded is the vast extent of shoals which encompass it on every hand, and upon nearly every one of which some vessel has been lost.

The chapter of wrecks is, perhaps, one of the saddest, as well as one of the most interesting in the history of

Nantucket. Lying as it does directly in the track of vessels plying between the principal American ports north and south of the island, the waves which dash upon its shores, or break in angry foam upon the shoals and rips near by, have reaped a harvest of shipwreck and death almost unparalleled upon the American coast.

Gautam, A.B. and A.W. Kitts. 1996. Data Description and Statistical Summary of the 1983-92 Cost-earnings Data Base for Northeast U.S. Commercial Fishing Vessels: A Guide to Understanding and Use of the Data Base. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Region, Northeast Fisheries Science Center.

Gautie, S.C. 1977. Geomorphology of the Southern Rhode Island Shoreline in Relation to Erosion and Accretion Characteristics.

Abstract: 106 beach profiles were surveyed along the south shore of Rhode Island from Napatree Point to Point Judith at 300 meter intervals. The shore consists of eight headlands with interconnecting barrier beaches. The surveys were conducted within a span of six days during the first week of October, 1976, to obtain a near synoptic quantitative survey of the beaches at the time of yearly maximum accumulation of beach material.

Analyzed were the spatial distribution of: berm height, back beach width, foreshore width, total beach width, dune base height, dune crest height, and foreshore slope in plan and profile. These data were used in conjunction with the mean annual rate of erosion and accretion, that was previously photogrammetrically determined at all of the same profile transect locations, to develop a model of the geometry and manner of change of the Rhode Island south shore.

The shore was divided into segments using the edges of headlands, centers of headlands, and inlets as boundaries. Combinations of segments included individual headlands and barrier beaches, headlands combined with barrier beaches, and segments derived by using the spatial longshore trend of the mean annual rate of erosion and accretion. Discriminant analysis indicates that there is a statistically significant difference between the shoreline segments used in the analysis. The dune base height and total beach width accounted for the difference. All other parameters show considerable overlap in plan among the beach segments.

The trends of the dimensions of the beach parameters, in plan, were determined using regression analysis. The trend of the dune base height increases along a segment at an average slope of 9.21 deg. The total beach width increases along a segment at an average slope of 64.70 deg. These calculated trends were correlated against the mean annual rate of erosion-accretion trends.

Using the information obtained by the analyses the south shore was divided into model segments. Each segment is described as follows.

During the period of maximum yearly accumulation of beach material the dune base height and total beach width increase in size from a headland towards the center of the beach segment. The erosion trend is also maximized towards the center of the beach segment. From the center towards the next adjacent headland and dune base height, total beach width and yearly erosion rate decrease. All other measured parameters are non-patterned.

These patterns are used as a model of beach geomorphology. Littoral drift moves sediment from west to east between adjacent headlands. The mid-section of the interlying barrier beach undergoes maximum landward migration. The rate of erosion then decreases towards the east. A fulcrum point is located near the eastern end of the barrier beach. The extreme eastern end undergoes accretion. Inlets are located at the eastern end of a barrier beach as a result of inlet migration with the direction of littoral drift, except where stabilized in other locations by man.

Germano, J.D. and D.C. Rhoads. 1989. Narragansett Bay Sediment Quality Survey, August 1988. Submitted to the Narragansett Bay Project. Rhode Island Department of Environmental Management. Providence, RI.

> **Abstract:** During the period 15 to 19 august 1988, SAIC performed a synoptic reconnaissance survey to assess benthic habitat and water quality and define benthic disturbance gradients throughout Narragansett Bay using three complimentary techniques: REMOTS sediment-profile photography, dissolved oxygen measurement, and measurements of the densities of Clostridium perfringens spores in the sediment. Overall, the most degraded habitat sampled was the upper Providence River Reach. This area exhibited low near-bottom dissolved oxygen levels, high Clostridium spore counts and low sediment quality as determined by REMOTS sediment profile photography.

Gerrier, P. 1981. The Distribution and Effect of Fishing of the Deep Sea Red Crab, *Geryon quinquedens Smith*, off Southern New England. M.S. Thesis. Southeastern Massachusetts University. North Dartmouth, MA. 130 pp.

Geyer, W.R. and R. Signell. 1990. Measurements of Tidal Flow Around a Headland with a Shipboard Acoustic Doppler Current Profiler. Journal of Geophysical Research. 95(C3):3189-3197.

> **Abstract:** A shipboard acoustic Doppler current profiler (ADCP) and moored current meters were used to obtain detailed measurements of the spatial structure of the tidal flow around a headland in Vineyard Sound, Massachusetts, where tidal currents typically range from 50 to 70 cm s^{-1}. Eight shipboard surveys were conducted, each of which followed one of five trapezoidal tracks in the vicinity of the headland, completing 11-12 circuits in the course of the tidal cycle (12.4 hours). The measurements from the ADCP compare favorably with moored velocity measurements at two locations (rms deviations of ± 3 cm s^{-1}), but the comparison showed more scatter at two other sites (rms deviations of plus or minus 7 cm s^{-1}). The ADCP measurements from separate cruises were merged to form a composite spatial representation of the tidal and residual currents, providing resolution of the spatial structure of the flow around the headland at scales from several hundred meters to 10 km. The semidiurnal tidal flow is relatively uniform in space, roughly following the bathymetry around the headland, while a residual current field consists of counterrotating eddies on either side of the headland, with spatial scales of 5-8 km and velocities as high as 25 cm s^{-1}. The instantaneous current field indicates the formation of transient eddies on the downstream side of the headland during flood and ebb, with clear evidence of flow separation near the tip of the headland. (DBO)

Gibeaut, J.C. 1986. Geological Aspects of Shoreline Management: A Summary for Southern Rhode Island I. Regional Depositional Systems and a Long-term Profiling Network. Vol. 1A. Plotted Profiles. Dept. of Geology, University of Rhode Island. Kingston, RI.

> **Abstract:** Plotted profiles from the Regional Depositional Systems and Long-Term Profiling Network. No Text or explanation of plots.

Gibson, M.R. 1995. Comparison of Trends in the Finfish Assemblage of Mt. Hope Bay and Narragansett Bay in Relation to Operations at the New England Power Brayton Point Station. A Report to the Brayton Point Technical Advisory Committee. Research Reference Document 95/1. June, 1995; Revised August, 1996. Rhode Island Division of Fish and Wildlife. 28 pp.

> **Abstract:** A detailed study of the Mt. Hope Bay fish population in the vicinity of the New England Power Brayton Point Station (NEPBPS) was undertaken. Early work by the Rhode Island Division of Fish and Wildlife (RIDFW) suggests that sharp reductions in the abundance of several fish species were coincident to operational changes at NEPBPS. These changes involved conversion of generating unit 4 from closed cycle to open cycle cooling, which resulted in a 45% increase in coolant flow drawn from Mt. Hope Bay. The coincidental declines in fish stocks were at odds with industry prediction during the permitting process of no impact. Further, interest has recently been shown by the industry in relaxing summer generation

limits imposed by the current permit. Consultants to New England Power have suggested that the fish declines were simply consistent with those occurring throughout the region as a result of overfishing, habitat loss, and natural variations. If so, concerns about increased summer generation would be greatly reduced. A review of plant environmental impacts is timely as the EPA NPDES permit is scheduled for renewal in 1998.

A number of statistical procedures were used to compare the hypothesis that fish population trends in Mt. Hope Bay were the same as in Narragansett Bay and other New England marine waters. Data from trawl surveys conducted throughout the region were compared. Species were compared individually and in aggregate. In 16 of 21 species compared, rates of decline in abundance were steeper in Mt. Hope Bay near NEPBPS. Moreover, aggregate resource abundance declined sharply in Mt. Hope Bay. In other areas, species replacements have occurred so that net abundance has been stable. A time series model showed that the sharp drop in abundance of fish in Mt. Hope Bay was coincident to the sharp increase in coolant flow at NEPBPS. While there was no evidence of species loss, reduced diversity in Mt. Hope Bay was apparent. More individuals are now concentrated in fewer species.

Other explanations such as overfishing and changes in natural mortality rate were rejected owing to the abrupt nature of the abundance declines. The most parsimonious hypothesis to explain the decline is that the large change in coolant flow has modified environmental conditions in Mt. Hope Bay to the detriment of the fish population. The available data suggest a temperature and/or oxygen mediated effect. Causality with NEPBPS cannot be demonstrated on the basis of current monitoring data. An experimental approach is required which is problematic since large scale interruptions in power generation are not feasible. A simulated experiment is required. This will require a detailed modeling capability, which is currently unavailable. This should be developed before any increase in summer power generation is allowed.

Gibson, M.R. 1998. Recent Trends in Abundance, Recruitment, and Fishing Mortality for Tautog in Narragansett Bay. Ref. Doc. 98/2 . Rhode Island Division of Fisheries and Wildlife Resources. 52 pp.

Gibson, S.G., S. Cole, P. Thorbahn, C. Wood, and M. Stachiw. 1979. Archeological Resource Study, Roger Williams National Memorial: Rhode Island. Cultural Resources Management Division, North Atlantic Regional Office, National Park Service, U.S. Dept. of the Interior. Washington, DC.

Abstract: This report discusses the prehistoric potential and historic land uses of the Roger Williams National Memorial located in downtown Providence, Rhode Island. The report is especially noteworthy for its copious and comprehensive documentary research. Owners and occupants of the property that comprises the Memorial are identified, and land use and development are traced from the late-17th century to the present. The potential for investigating problems related to urban historical archeology is very high.

Gilbert, T., A. Clay, and A. Baker. 1973. Site Selection and Study of Ecological Effects of Disposal of Dredge Materials in Buzzards Bay, Massachusetts. Report to Corps of Engineers, DACW 33-77-C-0024. New England Aquarium. 70 pp.

Giuliano, D.F. 1969. Biological Considerations in the BIFI Range. USL Technical Memorandum No 2213-9-69. U.S. Navy Underwater Sound Laboratory. New London, CT.

Abstract: Though much research has been conducted on the scattering of sound by marine organisms in the Deep Scattering Layers (DSL) of the world's oceans, investigations involving the amount of transmission loss or attenuation attributable to marine organisms in shallow water are virtually non-existent. There is little or no data involving the acoustic impedance of marine organisms, and any calculations of scattering strengths have usually been based on studies of scattering by spheres of contrasting material, such as air bubbles or oil droplets.

Weston (1967) has discussed the long-range attenuation due to bladdered fish over a shallow water acoustic range, and emphasizes the importance of considering this effect of fish in any low frequency underwater acoustic measurement.

The BIFI range in Block Island Sound is such a range, and there are bladdered fish present along this range. Many of these fish are found seasonally in schools where they swim either near the surface or in midwater. Presently, records are being obtained weekly of commercial fish catches in Block Island Sound and will be reported in a later paper.

The possible effects of the non-fish population on the acoustic signals is much more difficult to ascertain. Many authors (Moore, 1950, Boden, 1950, Tucker, 1951, Barham, 1957) have mentioned small shrimp-like crustaceans such as Euphausiids as being constituents of the DSL. The acoustic support for the inclusion of these animals in the sound scattering layer, however, is almost totally lacking except for Bary (1966) who states that in the concentrations present in Saanich Inlet, British Columbia, euphausiids do not contribute to the acoustic scattering in the DSL at 12 kHz. Calculations nor direct measurements of acoustic impedance, scattering strength or attenuation have been performed on animals of this type.

In shallow water such as Block Island Sound, there is no population of euphausiids or other wholly planktonic large shrimp-like crustaceans. However, large populations of shrimp-like crustaceans such as mysids, amphipods, and decapods do occur as well as other benthic invertebrate animals, which live in, on, or associated with the bottom and classed as epibenthic animals. These epibenthic forms undergo regular diurnal vertical migrations, seasonal vertical migrations, and swarming to the surface during mating seasons. These migrations bring large numbers, at least as great as concentrations found in the DSL, into the water column at periods ranging from part of a day or night to a whole season.

If these animals do scatter, and therefore probably attenuate sound, as many of the above authors believe, then they too should be investigated or monitored in a shallow water low frequency acoustic experiment.

Gleason, T.R. 1995. The Relationship Between Size and Survival for the Early Life History Stages of *Menidia beryllina* (Cope) in a Rhode Island Estuary (Predation, Size Classes). Ph.D. Dissertation. University of Rhode Island. Kingston, RI. 136 pp.

Abstract: Laboratory and field experiments were conducted to determine the relative importance of food limitation and predation as sources of mortality for Menidia beryllina larvae and juveniles. Two seven-day experiments using in situ mesocosms demonstrated that food was not limiting for larval growth or survival. A series of predation experiments offered four potential predator species a choice of 2 to 3 size classes of M. beryllina. Of the four species, only young-of-the-year (YOY) bluefish selectively preyed on the largest size class of M. beryllina. Gut content analysis of field collected predators indicated that only YOY bluefish demonstrated a propensity to prey on Menidia. The primary source of mortality for YOY M. beryllina in this system appears to be size-selective predation by YOY bluefish directed at the largest members of the cohort.

Otolith daily growth increments were used to back-calculate size-at-age in larval and juvenile M. beryllina. The back-calculated size frequency distributions were then compared to the size frequency distributions of field collections to determine if and when size-selective mortality occurred. Back-calculation of size-at-age indicated that in both 1990 and 1992 size-selective mortality occurred and was directed at the larger members of the M. beryllina cohort, though the timing of size-selective mortality varied between the two years. In 1990 size-selective mortality occurred during the juvenile stage, while in 1992, size-selective mortality occurred during the late larval and early juvenile stage. These results support our previous finding that size-selective mortality is directed towards the larger members of the M. beryllina cohort.

To explore the potential population level ramifications of reduced growth rate due to sublethal exposure to contaminants during the early-life-history stages of M. beryllina, a series of stage-classified matrix projection models was developed. Projections of the population-level effect of larval growth rate impairment on the population dynamics of this species depend on the balance between larval and juvenile

size-specific predation mortality (directed at the larger individuals) and the size-specific survival probabilities of subsequent stages (mortality potentially directed at the smaller individuals).

Gleason, T.R. and D.A. Bengtson. 1996. Growth, Survival and Size-selective Predation Mortality of Larval and Juvenile Inland Silversides, *Menidia beryllina* (Pisces; Atherinidae). Journal of Experimental Marine Biology and Ecology. 199(2):165-177.

Abstract: A series of laboratory and field experiments were conducted to determine the relative importance of food limitation and predation as sources of mortality for *Menidia beryllina* (Cope) larvae and juveniles. Seven-day experiments using in situ mesocosms to exclude predators demonstrated significant growth (mean instantaneous growth rate of 0.122-0.135 day^{-1}) and survival (mean 88–89%) for *M. beryllina* larvae in a Rhode Island, USA, estuary. These results suggest that food was not limiting for growth or survival and, therefore, that predation is likely the primary source of mortality for young-of-the-year (YOY) *M. beryllina*. Predation experiments were conducted in laboratory aquaria and in in-situ mesocosms to assess the size-selectivity of potential predators. Laboratory-reared striped bass, *Morone saxatilis* Walbaum and field-collected white perch, *Morone americana*, Gmelin, Crevalle jack, *Caranx hippos* Linnaeus and bluefish, *Pomatomus saltatrix* Linnaeus, were presented with a choice of two or three size classes of laboratory-reared *M. beryllina* and allowed to feed for 3–24 h. For field-collected predators the experimental prey size range was similar to the size present in the field. Striped bass, white perch and crevalle jack selectively preyed on the smallest size classes. Bluefish, however, selectively preyed on the largest size class. These results suggest that size-specific survival of YOY *M. beryllina* may vary spatially and temporally depending on the particular suite of predators encountered by individual populations or cohorts. However, in the estuary studied predation mortality appears to be directed towards the larger members of the *M. beryllina* cohort.

Gordon, R.B. and M.L. Spaulding. 1979. A nested numerical tidal model of the Southern New England Bight. Report to NOAA. Development of Three-Dimensional Numerical Pollutant Transport Modeling Techniques for Continental Shelf Applications. University of Rhode Island. Kingston, RI. 55.

Abstract: During earlier stages of this contract, efforts were focused on the development and application of a three-dimensional numerical model for predicting pollutant and sediment transport in estuarine and coastal environments. To successfully apply the pollutant and sediment transport model to Rhode Island coastal waters, it was determined that the flow field in this region had to be better described through the use of existing numerical circulation models.

As a first effort in this regard, a nested, barotropic numerical tidal model has been applied to the southern New England Bight (Long Island, Block Island, Rhode Island Sounds, Buzzards Bay, and the shelf south of Block Island). The numerical scheme employed is that of Greenberg (1977). This explicit finite difference scheme employs forward time and centered spatial differences with the bottom friction term being evaluated at both time levels. Horizontal friction and advective terms have been neglected.

Previous numerical studies of the tidal dynamics in this region were limited by inadequate information for the tide height boundary condition between Montauk Point, Block Island and Martha's Vineyard. Using existing tide records on the New England shelf, adequate information was available to specify the tide height boundary condition further out on the shelf. Preliminary results are generally within the accuracy of the National Ocean Survey (NOS) tide table data. Modeled co-range and co-tidal lines also agree with available data.

Goud, M.R. and D.G. Aubrey. 1985. Theoretical and Observational Estimates of Nearshore Bedload Transport Rates. Marine Geology. 64(1-2):91-111.

Abstract: Sediment transport rates in a shallow (<3 m) nearshore region are estimated using theoretical models and using bedform migration rates measured from vertical aerial photographs covering a 10 yr interval. Aerial photographs of the study area in Nantucket Sound, Massachusetts, showed low-amplitude

(tens of centimeters), long wave- and crest-length (tens to hundreds of meters), shore-normal sand waves in distinct geometrical patterns. The waves migrated an average of 10-20 m yr SUP -1 over a 10 yr period; the migration distances and bedform dimensions were used to calculate an average volume transport rate for the area. This rate was compared to bedload transport rates calculated using a Meyer-Peter and Muller model and a Bagnold model. Theoretical rates based solely on asymmetrical tidal currents are as much as an order of magnitude smaller than the observed rates, but inclusion of storm wave effects in the theoretical predictions brings them into better agreement with observations.-from Authors

Govoni, J. 1973. The Distribution of Some Marine Fish Eggs and Larvae in the Acushnet and Westport River Estuarine Systems, Massachusetts. Southeastern Massachusetts University. North Dartmouth, MA. 71 pp.

Abstract: To test for significant differences in densities of fish eggs and larvae inside, outside, and between the Acushnet and Westport River estuarine systems, Massachusetts, surface plankton net tows were made at six locations from February through May, 1972. Replicate and day versus night tows were made to assess catch variability and diel catch variation. Nine taxa of fish larvae including Ammodytes americanus, Myoxocephalus spp., Pseudopleuronectes americanus, Clupea harengus, Gadidae (Gadus morhua, Pollachius virens, and Microgadus tomcod), Lumpenus lumpretaeformis, Liparis atlanticus, Pholis gunnellus, and Enchelyopus cimbrius; and eight taxa of fish eggs including Enchelyopus cimbrius, Labrids (Tautogolabrus adspersus and Tautoga onitis), Scophthalmus aquosa, Brevoortia tyrannus, Stenotomus chrysops-Cynoscion regalis, Gadidae (Gadus morhua and Melanogrammus aeglefinus), Urophycis spp., and Limanda ferruginea were collected in 91 plankton tows. Catch variability of larval fishes was low relative to the catch variability of fish eggs. Clupea harengus , Liparis atlanticus, and Pseudopleuronectes americanus larvae were significantly more abundant in night tows.

This study did not reveal statistically significant differences in the density of fish eggs and larvae inside, outside, or between Acushnet and Westport River estuaries, Either no differences exist or the data obtained are inadequate to demonstrate a difference.

Grassle, J.F., J.P. Grassle, L.S. Brown-Leger, R.F. Petrecca, and N.J. Copley. 1985. Subtidal Macrobenthos of Narragansett Bay. Field and Mesocosm Studies of the Effects of Eutrophication and Organic Input on Benthic Populations. Pages 421-434 In: Gray, J.S. and M.E. Christiansen, (Eds.), Marine Biology of Polar Regions and Effects of Stress on Marine Organisms. John Wiley & Sons Ltd., NY.

Abstract: Benthic macrofaunal populations in Narragansett Bay and replicate mesocosms representative of portions of Narragansett Bay respond rapidly to variation in food supply. During five years of sampling sharp increases in August mortalities occur when estimated carbon demands for benthic respiration exceed the amount of organic carbon reaching the bottom. Rapid recovery following these periods of high mortality indicate a very resilient community. Benthic population densities in mesocosms rapidly increase in response to external additions of plant material, and to within system increases in productivity from nutrient additions. Larval immigration and predation are also important in determining population densities in the experimental systems but these variables are less easy to control and the effects are less obvious.

Graves, S.M. 1990. Morphotomology of Rhode Island Barrier Shores: A Method of Distinguishing Beach from Dune/Barrier Component Histories within a 29 year Record of Shore Zone Profile Data, with Special Reference to the Role of the Beach as a Buffer and Modulator [sic]of Erosional Coastline Retreat.

Abstract: 29 years of shore profile data collected at weekly, bi-weekly, and monthly intervals from Rhode Island's south shore have been re-examined to determine the role the active beach component plays in the complex history of coastal change. Each of more than 3600 individual plotted shore profiles taken at 10 locations has been dissected into active beach and inactive backshore/dune/barrier components, their respective volumes calculated, and the configuration of each beach unit assigned to either low, intermediate, or high volume, reflective, dissipative, and hybrid states. New time series of beach and non-beach profile component volumes are produced, and data sorted by month are presented in scatter plots.

These new data revealed distinct seasonal and annually repeated patterns of beach growth and depletion, and associated seasonal shifts from reflective to dissipative beach shapes, an expression of true seasonality in meteorologic conditions and associated wave climate. Moreover, the influence active beach "health" -a function of volume and shape- has on the susceptibility of backshore and dune/barrier erosional retreat has been demonstrated.

The stacked barrier/dune and overlying/fronting active beach profile volume time series has shown in addition to an annual beach cycle, a secondary multi-year signal of inactive backshore and foredune growth/depletion. Similar periodicities in total profile volume have been revealed through previously reported spectral analyses (Gibeaut, 1987). In addition, aerial photogrammetry [sic] of shoreline and duneline change over periods of 3, 5, and 10 years or more has revealed the secondary signal as out of phase dune and waterline relocations which describe a barrier-wide shift in overall shoreline orientation, apparently as a consequence of multi-year net longshore drift changes.

Recognition of a distinct hierarchy of sediment reservoirs present; and the appearance of separate but dependent histories for each -active beach, inactive backshore, and dune/barrier- as resolved by the techniques developed, provide details above and beyond those resulting from previously employed spectral and eigen approaches. Those techniques tend to oversimplify the importance of interactions among components of the total shore profiles. The new approach and results obtained reveal the previously stressed multi-year cycles as secondary phenomena, at least as far as processes are concerned, and show the most obvious signal instead to be one of seasonal and annual beach component changes.

Moreover, limitations in the effectiveness of previously employed techniques used in calculating the retreat rate of the coast based upon high water line photogrammetrics are pointed out; not the least of which is the sometimes misleading implications those results have generated for coastal zone management's implementation of construction setback policies. The suggestion is made here that documentation of coastal change and projections of future retreat, should be based upon identifying and measuring changes in the landward-most positions of the erosional barrier profile. This feature corresponds to the interface between barrier and fronting/capping transient beach and dune sediment bodies, and is by far a more stable feature than the high water line whose position changes dramatically with beach configuration.

A new and more precise description of the process-responses of shore zone components along the south coast of Rhode Island has resulted from the approaches taken in this study. The barrier-spit beaches are envisioned as being a part of a distinct hierarchy of sediment reservoirs built, maintained, and slowly translated landward by waves, wind, and tide. There, beaches act or respond as a primary buffer of storm wave effects, and modulate long-term retreat of the backing/underlying dune and barrier units. The dunes are secondary sediment reservoirs and buffers. Their slowly accumulated aeolian and interbedded washover deposits are eroded only by the more severe storms of late fall and winter when the volume of the beach reservoir is at a minimum, and by infrequent extreme events. Where the shore fronts headlands, the beaches alone provide the buffering of storm wave erosion.

Gray, C.L. 1991. Winter Flounder (*Pseudopleuronectes americanus*) Species Profile. NBP-91-56. Pages 21-27. Narragansett Bay Project. Rhode Island Dept. of Environmental Management, Division of Fish and Wildlife, Marine Fisheries Section. Providence, RI.

Abstract: This winter flounder profile is the initial document in a series intended to provide background necessary for cooperative management of important finfish species occurring in Rhode Island waters.

Winter flounder support a very important and valuable fishery in Rhode Island, contributing to the bulk of the commercial and recreational fisheries. Catches of winter flounder in statistical area 539, which includes Narragansett Bay, have declined 53% since landings peaked in 1982. Commercial catch per unit effort has also declined 59% since 1982. Abundance indicators remain well below the all time highs reached in 1979.

This review of the biology of winter flounder, *Pseudopleuronectes americanus*, includes nomenclature,

taxonomy, ecology, stock description, range, abundance in Rhode Island waters, life history, habitat requirements, migration and movements. Also included are reproduction, growth and development, food and feeding, predators, disease and parasites. In addition to the commercial and recreational value of the fishery a summary of Rhode Island regulations is also included.

Winter flounder eggs are demersal and adhesive, larvae are non-buoyant and display a mixed planktonic-benthic behavior. After metamorphosis winter flounder are benthic and juveniles spend their first two years in or near shallow natal waters and move seaward with age. Adult winter flounder are demersal and reach sexual maturity in the average of 2.84 years, in Southern New England.

Additional management measures for winter flounder are currently being debated by the Rhode Island Marine Fisheries Council.

Grigalunas, T.A., J.J. Opaluch, M. Luo, and Y.-T. Chang. 2001. Estimating Environmental Costs in Port Development: A Case Study of the Economic Costs to Fisheries of Marine Disposal of Clean Dredge Sediments. Transportation Research Record n 1756. Pages 94-99 In: Proceedings, NRC, Transportation Research Board Annual Conf., Washington, D.C.

Abstract: The economic assessment of potential external costs due to port development is considered. The importance of environmental cost estimates in making decisions about port development is outlined. A case study in Rhode Island is used to illustrate quantification of one important environmental issue-the economic cost to commercial and recreational fisheries resulting from marine disposal of dredged material. The bio-economic framework, data, and assumptions used are described. Key results are summarized for seven potential disposal sites for 5.1 million cubic yards of clean dredge sediment, three in Narragansett Bay and four in Rhode Island Sound. To reflect the many sources of uncertainty in the analysis, an overstated cost approach is used and several sensitivity analyses are presented. Results suggest that costs of sediment disposal for bay sites are higher than for Rhode Island Sound sites and support including long-term and ecological effects, and recreational as well as commercial losses, in assessments of potential sites for disposal of dredge material. 18 Refs.

Grimes, B.H., M.T. Huish, J.H. Kerby, and D. Moran. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) Summer and Winter Flounder. USFWS Biological Report 82 (11.112); U.S. Army Corps of Engineers, TR EL-82-4. U.S. Fish and Wildlife Service. 18 pp.

Abstract: Species profiles are literature summaries of the taxonomy, morphology, range, life history, and environmental requirements of coastal species. They are designed to assist in environmental impact assessments. The summer flounder supports an important commercial and recreational fishery in the Mid-Atlantic and are important constituent of estuarine and continental shelf systems throughout the region. Summer flounder spawning begins in September and winter flounder spawning begins in June. Summer flounder eggs are pelagic whereas winter flounder eggs are demersal. Summer flounder larvae are more abundant in inlets, and juveniles are found in estuarine seagrass beds in salinities ≥ 12 ppt. Winter flounder juveniles are abundant in shallow bays and estuaries, moving seaward in spring and summer. Growth of winter flounder and summer flounder is seasonal. There are probably three spawning populations of both species, which produce a complex stock pattern. Summer flounder are tolerant of a wide range of chemical and physical factors, but prefer > 10 ppt salinities. Winter flounder optimal temperature is 18.5 °C. Diseases of winter flounder are more prevalent in polluted waters. Summer flounder are tolerant of sediments laden with contaminants.

Grove, C.A. 1982. Population Biology of the Winter Flounder, *Pseudopleuronectes americanus*, in a New England Estuary. University of Rhode Island. RI. 95 pp.

Abstract: Spawning locations of the winter flounder, Pseudopleuronectes americanus, in Point Judith Pond, Rhode Island, were determined in the winter of 1991. An epibenthic sled was used to sample for

eggs at 13 areas over a 5-week period. Eggs were present only in two areas of the upper estuary that had hard bottom and algal mats to which the demersal eggs adhered.

A hydrodynamics model indicated the conservative nature of Point Judith Pond as a winter flounder rearing area. The concentration of larvae in the upper estuary where current velocities are low and in Potter Pond where a 2-3 hour phase lag exists, were major factors in the retention of larvae in the estuary. The design of the breachway and the breakwaters of the Harbor or Refuge reacted like a holding tank for water and larvae and thus also aided in reduction of offshore dispersal.

Spawning activity was interrupted or decreased mid-way through the investigation due to a sudden drop in temperature. This interruption was observed during collection of eggs and was manifested in subsequent larval abundances.

A population estimate was made of adult winter flounder in Point Judith Pond from May 5 to June 18, 1981. The Jolly mark-recapture method yielded weekly abundances ranging from 26,000 to 56,000 flounder in the study area or 130-285 flounder/hectare. Mean catch per unit effort and the calculated emigration/immigration term indicated a pulse of emigration occurred the last week of May. A gradual increase in the proportion of females suggested that males left the pond first. During fall immigration, recaptures of tagged fish by recreational fishermen indicated the flounder returned only to the area of release.

Haas, R.E. and C.W. Recksiek. 1994. Age Verification of Winter Flounder in Narragansett Bay. Transactions of the American Fisheries Society. 124(1):103-111.

Abstract: Between October 1987 and December 1988, 732 winter flounder Pleuronectes americanus, 91-380 mm total length, were collected during biweekly sampling from Narragansett Bay, Rhode Island. Left sagittal otoliths from these fish were embedded in epoxy resin, and transverse sections through the foci were prepared. With hyaline zones considered as annual increments, ages ranged from 1 to 11 for 608 winter flounder; 97% of the fish were younger than age 5. The dorsoventral otolith diameter was determined by linear regression analyses to be the best (r super(2) = 0.90) of six “radial” axes for increment measurements. Marginal increment analyses for ages 1-4 showed that the increments, each composed of one opaque and one hyaline zone, are deposited annually, which clearly verified sectioned otolith ages for age-2 and age-3 fish. Opaque edges were prevalent in May, June, and July. Sectioned otoliths from winter flounder can provide clear increments and measurable increment widths through age 11. Two individuals read 369 sectioned otoliths and 116 whole otoliths; one individual read 155 scales twice. Precision between readers and aging methods was relatively high (average percent error, 1.5-4.5). Comparison of ages from scales and whole and sectioned otoliths from 154 fish showed no significant differences (P less than or equal to 0.05).

Haight, F.J. 1936. Currents in Narragansett Bay, Buzzards Bay, and Nantucket and Vineyard Sounds. 2nd ed., revised. Spec. Publ. U.S. Coast Geod. Surv. 208. Washington, DC. 103 pp.

Abstract: In the preparation of this volume, the aim has been to collect, correlate, and present in usable form the mass of data derived from current observations taken at various times in Narragansett Bay, Buzzards Bay, Vineyard Sound, and Nantucket Sound, to the end that basic material in the files of the Coast and Geodetic Survey may be available for the use of the many individuals and interests desiring it, and at the same time be insured against loss or destruction to which all unpublished records are liable.

Most of the results presented are based upon observations taken in connection with surveying operations of the Coast and Geodetic Survey. They date back to the year 1844 and include data from recent comprehensive current surveys covering the waterways mentioned above. Some of the observational material was furnished by, or obtained in cooperation with, other organizations.

Hampson, G.R. 1987. Ground Truth Verification of a REMOTS Survey of Buzzards Bay. Draft Report to Buzzards Bay Project. Woods Hole Oceanographic Institute. Woods Hole, MA. 18 pp + appendices.

Hampson, G.R. 1964. Redescription of a Commensal Pelecypod, *Rochefortia cuneata,* with Notes on Ecology. Nautilus . 77(4):125-129.

Abstract: The object of this paper is to describe and illustrate again *Rochefortia (Pythinella) cuneata*, a commensal pelecypod. Previous illustrations have not clearly shown the critical taxonomic characteristics to facilitate identification. Because the original description by Verrill and Bush 1898 makes no mention of the ecology of this species, and because there has been no subsequent literature on its ecology, a brief description of the association of *R. cuneata* with its host is included.

Hampson, G.R. 1971. A Species Pair of the Genus *Nucula* (Bivalvia) from the Eastern Coast of the United States. Proceedings of the Malacological Society of London. 39(5):333-342.

Abstract: As part of an ecological survey of soft-bottom communities in the region of Buzzards Bay, Massachusetts, a number of samples were collected at Sta. R. located at 41°30'N, 70°53'W (about 3 miles NW of Quicks Hole at 20 m depth) (Sanders, 1960), and the entrance of Quissett Harbor, Massachusetts. At both stations the genus *Nucula* is a very important component of the fauna. In the past, individuals of this genus from both areas have been identified as *Nucula proxima* (Say, 1822). However, detailed comparison of specimens from the two localities reveal small but distinct morphological differences. A study of these specimens and additional material from many localities along the eastern coast of the United States and Canada, shows that these two forms are distinct species.

Nucula proxima lives in sandy sediments such as that found in Quissett Harbor while *Nucula annulata* n. sp. is found only in muddy sediments (Sanders, 1958, 1960). Their geographical ranges overlap but they are nearly isolated ecologically.

It is sometimes difficult to separate the largest individuals of these two species solely on external shell morphology (Scheneck, 1934). However, they can readily be separated on the basis of internal anatomy.

Hannan, C.A. 1984. Initial Settlement of Marine Invertebrate Larvae: The Role of Passive Sinking in a Near-bottom Turbulent Flow Environment. MIT/WHOI Joint Program, Woods Hole Ocean Inst. Woods Hole, MA.

Abstract: The hypothesis that planktonic larvae of benthic invertebrates sink through the water like passive particles in turbulent flows near the seabed was tested in the field using several groups of geometrically different sediment trap designs. A priori predictions regarding the rank order that the various traps would collect larvae in the field were dictated from laboratory flume experiments to determine the relative particle collection efficiencies of traps. The flume flow was seeded with particles having fall velocities similar to those measured, in the laboratory, for nonswimming polychaete larvae. The flume flow speed (of ~ 10 cm/sec) was within the range of near-bottom current velocities measured during trap collecting intervals at the study site.

In seven field experiments, each lasting from one to eleven days, trap collections of Mediomastus ambiseta (a polychaete worm) postlarvae, total bivalve larvae and postlarvae, sabellariid polychaete larvae, and enteropneust postlarvae generally fit the patterns predicted for passive particle collections between or among the trap designs. While the results were statistically more significant during some intervals than during others, the rank order of larval collections within each group of trap designs tested nearly always corresponded precisely to the rank order of passive particle collections by the traps in the flume experiments. Thus, the hypothesis that larvae sinking toward the seabed in the field and passive particles (with fall velocities similar to larvae) sinking in a flume are collected in the same rank order of abundance by near-bottom traps could not be falsified for collections of organisms from three invertebrate phyla.

Collections of the polychaete, Pectinaria gouldii, and of metamorphosing seastar larvae between or among trap designs significantly differed from the patterns predicted for passive particle collections. A testable hypothesis to explain the Pectinaria collections involves unique hydrodynamic properties of these postlarvae, relative to the other organisms collected, and is consistent with the passive sinking hypothesis. Trap collections of the seastars may have resulted, at least in part, from larvae adhering to solid trap surfaces during metamorphosis.

The passive sinking hypothesis could not be falsified in most of the field experiments conducted in this study. Thus, hydrodynamical processes must be included in any future studies of processes that determine patterns of larval settlement. However, passive sinking by larvae is not the explicit result of this experimental study. Other processes that could have produced the observed patterns of larval collections among the trap designs now must be tested against the passive sinking alternative hypothesis. However, much more information on the biology and ecology of the larvae collected in this study is required before future process-oriented experiments can be designed.

If larvae sink like passive particles to heights of ~ 50-cm above the seabed, as the results of this study suggest, then it is possible that larvae initially reach the seafloor at sites where particulates, with fall velocities similar to larvae, initially settle. This hypothesis requires experimental testing. Larvae may not remain at these initial settlement sites; however, after larvae initially reach the seafloor via passive physical processes, the larvae may redistribute by actively choosing a preferred microenvironment within that location, by actively swimming above the bottom or remaining on the sediment surface to be resuspended and transported away, by resuspension only during storm events, and/or by passively accumulating around microtopographic structures.

As a precursor to the flume tests of traps, a theoretical analysis of the physical nature of trap biases was conducted. A dimensional analysis of the independent variables involved in the process of trapping particulates suggested that trap collection efficiencies should be a function primarily of trap Reynolds number, trap aspect ratio, the ratio of the fluid velocity to the particle fall velocity, and trap geometry. A review of data from previous studies that flume-tested various trap designs further suggested that particle collection efficiencies of cylindrical traps should decrease over some range of increasing trap Reynolds number, decrease over some range of decreasing particle fall velocity and increase over some range of increasing trap aspect ratio. Theoretical models were then provided to account for these effects. Flume tests, in the present study, of cylinders varying by one order of magnitude in trap Reynolds number supported one of the predictions: particle collection efficiencies of the cylinders decreased by a factor of two over this range of increasing trap Reynolds number. Results of this theoretical and experimental study of trap collection characteristics suggest that more flume experiments to quantitatively determine the nature of trap biases are required before flux estimates, using traps in the field, can be adequately interpreted.

Hannesson, R. 1978. Economics of Fisheries: An Introduction. Universitetsforlaget. Bergen. 156 pp.

Abstract: Fish resources have undoubtedly become increasingly scarce during the last hundred years or so and few believe any longer that fish stocks are undepletable. This book raises the question of optimal resource utilization, arguing that the optimal exploitation of fish resources implies utilizing the growth capacity of the species while avoiding a total depletion of the fish stock. An attempt has been made at integrating fishery biology and economics but with a heavy bias towards economics.

Harding, G.C. 1992. American Lobster (*Homarus americanus Milne Edwards*): A Discussion Paper on their Environmental Requirements and the Known Anthropogenic Effects on their Populations. Canadian Technical Report of Fisheries and Aquatic Sciences 1887. 16 pp.

Hargraves, P.E. 1988. Phytoplankton of Narragansett Bay. Pages 136-142 In: Sheath, R.G. and M.M. Harlin, (Eds.), Freshwater and Marine Plants of Rhode Island. Kendall/Hunt Pub. Co, Dubuque, Iowa.

Abstract: Phytoplankton dynamics in Narragansett Bay are regulated by an array of environmental parameters including light, temperature, nutrients, grazing, and species interactions (see, inter alia.

Hitchcock and Smayda, 1977; Furnas et al., 1976; Kremer and Nixon, 1978; Smayda, 1973b and 1983; Vargo, 1976). The Bay is a rather shallow estuary (mean depth = 9 m), well mixed throughout the year, with a surface salinity gradient of about 12–32 ‰, and an annual temperature range of about –1.5° to near 30°C.

Primary production in Narragansett Bay is of the order of 300 g C $m^{-2}y^{-1}$ (Furnas et al., 1976) but there is considerable internal variation. Productivity is at its highest during the winter-spring diatom bloom and during the summer nanoplankton blooms (Durbin et al., 1975). Except during the winter-spring diatom bloom, nanoplankton (<20µm) are responsible for the major part of primary production (over 50% annually, near 90% in summer; Durbin et al., 1975). Likewise, nearly half the annual standing crop (as chlorophyll *a*) of phytoplankton is <20 µm, with a peak in summer of nearly 80% of the total. The nanoplankton can exceed 50 mg m^{-3} of chlorophyll *a* at this time (Durbin and Durbin, 1981). In the upper Bay, standing crop (as chlorophyll *a*) and production can be 2–4 times that of the lower Bay. As a general rule the significance of nanoplankton increases from lower to upper Bay.

Harris, J.S. and J.T. DeAlteris. 1992. Preliminary Analysis of Selectivity of 14.0 cm (5.5 in) and 15.2 cm (6.0 in) Square and Diamond Mesh Cod-ends for Yellowtail Flounder in New England Commercial Bottom Trawls. Pages 416-420 In: MTS '92: Global Ocean Partnership. Proceedings Marine Technology Society Conference. Washington, DC, October 19, 1992-October 21, 1992. MTS. Washington, DC.

Abstract: Four experimental cod-ends, 14.0 cm (5.5 in) square and diamond mesh and 15.2 cm (6.0 in) square and diamond mesh cod-ends were compared with a 10.2 cm (4.0 in) diamond mesh cod-end on a commercial fishing boat targeting yellowtail flounder (Limanda ferruginea) in southern New England waters. The alternate haul method was used. From this data selectivity curves were generated using nonlinear regression. Fifty percent retention lengths for each of the nets were determined: 38.6 cm (15.2 in) and 34.9 cm (13.7 in) for 15.2 cm (6.0 in) diamond and square mesh cod-ends, respectively, and 34.7 cm (13.7 in) and 31.4 cm (12.4 in) for 14.0 cm (5.5 in) diamond and square mesh cod-ends, respectively. The diamond mesh cod-ends produced narrower selection ranges than the square mesh cod-ends of the same mesh size.

Helser, T.E., E.M. Thunberg, and R.K. Mayo. 1996. An Age-structured Bioeconomic Simulation of U.S. Silver Hake Fisheries. North American Journal of Fisheries Management. 16(4):783-794.

Abstract: We present a bioeconomic simulation of the U.S. fisheries for silver hake Merluccius bilinearis, an abundant species distributed over the Northwest Atlantic continental shelf and historically important to both U.S. and foreign fishing fleets. The model combines elements of age-structured population and harvest yield models with a two-equation price response model. The analysis evaluates biological benefits of interest to managers, such as future yields or rebuilding of parental stock, as well as future revenues and net present value of interest to harvesters. In one set of simulations, yield and revenue response surfaces were generated for varying levels of fishing mortality (F) and selection at age under constant annual recruitment. In another, a stochastic stock-recruitment function permitted assessment of yield and revenue trajectories over time given variable annual recruitment. Under equilibrium conditions, response surfaces for both total fishery yield and revenue are asymptotic with increasing fishing mortality rates. This result suggests that little yield or revenue would be lost if fishing mortality were reduced to less than 0.5. Maximum revenue occurs at slightly greater Fs and with a selection pattern favoring slightly younger fish than is the case for yield maximization. Simulation results, incorporating variable recruitment, indicate that considerable long-term biological and economic benefits accrue when fishing mortality rates are moderate (F = 0.35 and F = 0.50 for the northern and southern stocks, respectively) and the age at capture is delayed until age 3 (50% selection at age 3). Over a 10-year simulation horizon, yield to the fishery increases by 80%, and spawning stock biomass almost doubles, resulting in significant stock rebuilding. Although lower revenues occur in the early years, higher revenue streams are realized later on, producing significant long-term gains. The net present value of a stock rebuilding strategy was estimated at US$ 150 million. Other harvesting strategies examined resulted in lower present values.

Hennessey, T. and M. Healey. 2000. Ludwig's Ratchet and the Collapse of New England Groundfish Stocks. Coastal Management. 28(3):187-213.

Abstract: The stocks of principal groundfish species off New England have collapsed, creating economic hardship and dislocation in fishing communities from Rhode Island to Maine. In this article the authors analyze the causes of this collapse using the "ratchet effect" described by Ludwig, Hilborn, and Walters (1993) as a framework. According to Ludwig, Hilborn, and Walters, powerful economic and political interests drive fisheries to overcapitalize and overexploit despite scientific evidence that stocks are declining. When the fishery is no longer economically viable, governments provide financial assistance to minimize economic hardship. When stocks increase there is another rush to invest, and the cycle repeats itself. The history of groundfish management in New England conforms well to this model. Optimism among fishers and government over U.S. control of this fishery in 1977 stimulated successive rounds of investment that built up excessive fishing capacity despite warnings from scientists that stocks were becoming weaker. Management regimes designed by the New England Fishery Management Council were ineffective in constraining fishing effort. Collapse of the stocks has led to severe restrictions on fishing and to government assistance. It is suggested that the integration of science, management, and harvesting sectors through ecosystem-based management offers the best means of avoiding similar situations in the future.

Herman, S.S. 1963. Planktonic Fish Eggs and Larvae of Narragansett Bay. Limnology and Oceanography. 8:103-10.

Abstract: Planktonic fish eggs and larvae were collected weekly at 4 stations in Narragansett Bay, over a period of one year from March 1957 to March 1958. Thirty-six species of fish eggs and larvae were identified.

The peak in spawning activity occurred from late May through mid-August. The peak of fish egg production occurred in June and July, and the period of low abundance occurred between September and February. Peaks of larval abundance were found in July and August and again in January and March. Deeper areas in the Bay contained greater concentrations and a greater variety of species than did the shallow areas.

Hickey, J.M. 1983. Assessment of Quahog Stocks in Contaminated Waters of Southeastern Massachusetts. Massachusetts Division of Marine Fisheries.

Abstract: A survey of the deepwater quahog resource in contaminated waters of the New Bedford Harbor-Clarks Cove and Taunton River-Mt. Hope Bay regions was conducted by DMF in 1980 and 1981. A standing crop of 483,212 bushels was estimated for the former region and 137,972 bushels for the latter, in the area surveyed. Net depurable standing crop in moderately contaminated waters was estimated at 419,216 bushels in New Bedford Harbor-Clarks Cove and 111,101 bushels in Taunton River-Mt. Hope Bay. Total depurable standing crop amounted to 530,317 bushels, 74% of which are chowder sized. Estimated value of this resource is about $6,959,616.00

Approximately 2,328 acres were unsampled between the two regions because of inaccessibility with a dredge boat. About 1,339 acres of the unsampled area is thought to be moderately to highly productive.

Predation was not found to be a significant factor in the population dynamics of either region.

Hicks, S.D. 1959. The Physical Oceanography of Narragansett Bay. Limnology and Oceanography. 4:316-327.

Abstract: Analyses of pertinent data from various physical oceanographic programs carried out in Narragansett Bay are presented in an effort to give a useful description of tidal characteristics, temperature and salinity distributions, and the nontidal circulation. The observed tides and tidal currents are shown to

be the result of a standing tidal wave with a slight progressive component and a damping coefficient of 1.6. Both temperature and salinity distributions indicate essentially homogeneous bottom water in the upper part of the Bay as contrasted with the surface layer, which possesses marked progressive changes over the same area. One direct measurement and the salinity distribution seem to confirm the non-tidal circulation calculations, which are based on river run-off, surface nontidal currents, and cross sectional areas. Narragansett Bay appears to be an estuary in which the salt balance is maintained, under steady state conditions, by horizontal advection, vertical advection, and vertical eddy diffusion.

Hicks, S.D., D.E. Frazier, and A.P. Taylor. 1956. Wind Wave Characteristics of Rhode Island Waters. Volume University of Rhode Island Reference No. 56-3 Hurricane Protection Project. University of Rhode Island, Narragansett Marine Laboratory.

Abstract: Contains wave height data obtained form measurements and observations at Charlestown beach, Point Judith, Scarborough beach, and Fort Varnum. Figures and table show data for the period of August 1954 to September 1955.

Higgins, B.J. 1972. Surface Circulation of Nantucket Sound as Determined by Drifters. Sea Grant Technical Report No. 33. Pages 85-123. Michigan University, Sea Grant Program. Ann Arbor, Michigan.

Abstract: On May 11, and 25, 1972, surface drifters were released in three patterns across Nantucket Sound. The drifters were of four types to compare the responses of various types to the wind and currents. Of the 891 released, 289 (32.5%) were recovered and plotted.

In summary, it appears that: 1) drift bottles released near shore generally follow tidal flow and are not influenced by winds, 2) surface flow is influenced by the wind in locations of weak tidal action, 3) drifters of the type made of forming waterproof envelopes are influenced to such a degree by the wind that it is doubtful that they indicate the true movement of the surface flow, and 4) surface flow in the sound is not easterly if the winds are over 20 mph and from the northeast or northwest.

Hinga, K.R. 1992. Contaminated Sediments in Narragansett Bay: Severity and Extent. Narragansett Bay Project. Providence, RI.

Abstract: A common practice throughout the industrial history of mankind is the discharge of unwanted, and sometimes dangerous, chemicals to estuarine and coastal waters. In many instances these chemicals come to be concentrated in the sea-floor sediments. Upon exposure to the chemicals in the sediments, both human health and the health of plants and animals in the environment may be at risk. The question to be answered is if the contaminated sediments around Narragansett Bay are causing, or in some circumstances can cause, damage to human or to wildlife populations. This report examines if sediments in parts of Narragansett Bay can be considered toxic. If so, then how is the level of contamination in Narragansett Bay likely to impact navigational (and construction) dredging and the need for remedial actions.

Hoff, J.G. 1971. Mass Mortality of the Crevalle Jack *Caranx hippos* (L.) off the Atlantic Coast of Massachusetts. Chesapeake Science. 12(1):49.

Hoff, J.G. and R.M. Ibara. 1977. Factors Affecting the Seasonal Abundance, Composition and Diversity of Fishes in a Southeastern New England Estuary. Estuarine and Coastal Marine Science. 5(5):665-678.

Holmes, R.D., C.D. Hertz, and M.T. Mulholland. 1998. Historic Cultural Land Use Study of Lower Cape Cod. Prepared for The Archeology Branch, Cultural Resources Center, Northeast Region, National Park Service, U.S. Department of the Interior. Lowell, Massachusetts. 279 pp..

Abstract: This is a report that defines, describes, and graphically illustrates the historical contexts within which archeological resources may be identified, located, interpreted, and evaluated. It assesses the

relative importance of each context so that management decisions may be made for resource preservation and protection. It discusses the archeological implications of each context. Archaeologically sensitive areas are identified on the basis of previous research, field surveys, documentary evidence, and the expectations derived from the historic contexts.

Holohan, B.A., E.G. Klos, and C.A. Oviatt. 1998. Population Density, Prey Selection, and Predator Avoidance of the Burrowing Anemone (*Ceriantheopsis americanus*) in Narragansett Bay, Rhode Island. Estuaries. 21(3):466-469.

Abstract: The maximum population density of the burrowing anemone (Ceriantheopsis americanus) was estimated at 17-28 animals m super(-2) in soft-bottom sediments of mid Narragansett Bay. The gut contents of the anemone indicated primary prey of harpacticoid and calanoid copepods. The consumption of calanoid copepods was higher in October than April, which may be due to decreased density of hapacticoids in the fall. The anemones apparently avoid fish predation in late summer by withdrawing into the sediments. After the seasonal fall migration of fish out of the bay, anemones reappear.

Howe, A.B. and P.G. Coates. 1975. Winter Flounder Movements, Growth, and Mortality off Massachusetts. Transactions of the American Fisheries Society. 104(1):13-29.

Abstract: From 1960 to 1965, 12,151 winter flounder (*Pseudopleuronectes americanus*) were tagged with Petersen tags at 21 locations off Massachusetts. Returns through 1971 totaled 4,440 or 36.5%. Ratio of females to males at tagging was 2.3. Movements north of Cape Cod were relatively localized and confined to inshore waters, whereas south of Cape Cod, flounder seasonally dispersed in a southeastward direction generally beyond the territorial limit; movements appeared to be related to water temperature. Little mixing occurred between Georges Bank and inshore areas. Growth of fish north of Cape Cod, south and east of Cape Cod, and on Georges Bank was described by "Walford lines" developed from tagging data. In 1964 apparent rates of exploitation, natural mortality, and annual total mortality were 0.201, 0.273, and 0.474, respectively, for fish released in Vineyard and Nantucket Sounds.

Howe, A.B., P.G. Coates, and D.E. Pierce. 1976. Winter Flounder Estuarine Year-Class Abundance, Mortality and Recruitment. Transactions of the American Fisheries Society. 105(6):647-657.

Abstract: Mark-recovery methodology, accounting for mortality, enabled annual estimates of estuarine winter flounder (*Pseudopleuronectes americanus*) abundance at summer's end. Recruitment from the estuarine system to an inshore-offshore otter trawl fishery occurred incompletely (73%) over three age groups (II-IV). The release of tagged pre-recruits in two consecutive years and subsequent return data, adjusted for non-reporting of tag recoveries, yielded the following 1970 post-recruit, instantaneous mortality parameters: total = 0.3570, fishing = 0.2445, natural = 0.1125. A comparison of total recruitment from southeastern Massachusetts flounder groups, derived from a population estimate and instantaneous total mortality rate, with recruitment from the Waquoit Bay-Eel Pond system indicated that the latter constituted less than one percent of the total required to maintain equilibrium catch.

Howe, A. B., T.P. Currier, J.R. King, R. Johnston. 2002. United States Fish and Wildlife Service Federal Aid to Sport Fish Restoration Act. Annual Report January 1 - December 31, 2001. Project No. F-56-R

The Massachusetts Division of Marine Fisheries Resource Assessment Project conducted bottom trawl surveys of Massachusetts territorial waters from 8-23 May and 5-20 September, 2001. Their completion marked the twenty-fourth year of surveys.

Survey coverage extended from New Hampshire to Rhode Island boundaries seaward to three nautical miles including territorial waters of Cape Cod Bay and Nantucket Sound, both areas of special jurisdiction to Massachusetts' fisheries management. Cruise objectives were: 1) to determine the distribution and

relative abundance of fish species in state waters; 2) to collect biological samples; and 3) to collect physical data - geographic location, depth, and hydrographic information. Special collections were also undertaken at the request of cooperating scientists.

The waters delineated above were stratified into geographic zones (strata) based on depth and area (Figure 1). Trawl sites were allocated in proportion to stratum area and chosen randomly within each sampling stratum. Sites were occasionally relocated due to concentration of fixed gear or because of untowable bottom.

A 20-minute tow at 2.5 knots was undertaken at each station from the chartered NOAA R/V GLORIA MICHELLE with a 3/4 size North Atlantic type, two seam otter trawl (11.9 m headrope - 15.5 m footrope) rigged with a 19.2 m chain sweep with 7.6 cm rubber discs; 18.3 m bottom legs of 9.5 mm chain; 19.2 m wire top legs; and, 1.8 × 1.0 m, 147 kg wooden trawl doors. The net contained a 6.4 mm mesh codend liner to retain small fish.

Standard bottom trawl survey techniques were used when processing the catch. Generally, the total weight (nearest 0.1 kg) and length-frequency (nearest cm) were recorded for each species on standard trawl logs. Age and growth materials (hard parts) as well as maturity and pathology observations were collected during the measuring operation. At each station, we measured surface and bottom temperatures and surface salinity using a marine hydrographic instrument.

Howe, A.B., T.P. Currier, S.L. Sass, and B.C. Kelly. 1983. Coastwide Fishery Resource Assessment. Massachusetts Division of Marine Fisheries.

Howe, A.B., T.P. Currier, S.L. Sass, and B.C. Kelly. 1984. Coastwide Fishery Resource Assessment. Massachusetts Division of Marine Fisheries.

Howe, A.B., T.P. Currier, S.L. Sass, and B.C. Kelly. 1985. Coastwide Fishery Resource Assessment. Massachusetts Division of Marine Fisheries.

Howe, A.B. and B.T. Estrella. 1978. Fishery Resource Assessment: Winter Flounder and Other Species. National Marine Fisheries Service, Report No. NOAA-78082301. Gloucester, MA. 81 pp.

Howe, A.B., B.T. Estrella, F.J. Germano, Jr., J.T. Buckley, and D.B. MacIsaac. 1980. Coastwide Fishery Resource Assessment. Pages 1-26. Massachusetts Division of Marine Fisheries.

Howe, A.B., F.J. Germano, J.T. Buckley, D. Jimenez, and B.T. Estrella. 1981. Coastwide Fishery Resource Assessment. Pages 1-32. Massachusetts Division of Marine Fisheries.

Howe, A.B., D.B. MacIsaac, B.T. Estrella, and F.J. Germano, Jr. 1979. Coastwide Fishery Resource Assessment. Pages 1-37. Massachusetts Division of Marine Fisheries.

Howes, B.L. and D.D. Goehringer. 1996. Ecology of Buzzards Bay: An Estuarine Profile. Biological Report 31. National Biological Service. Washington, D.C. 141 pp.

Abstract: The purpose of this report is to provide an overview of the ecology of the Buzzards Bay ecosystem. After a general introduction to the system, the formation of the bay is discussed in Chapter 2, followed by descriptions of the physical (Chapter 3) and biological (Chapter 4) components of the system and their interaction. Chapter 5 addresses watershed land use and water quality issues within the bay proper and its circulation-restricted coastal embayments, while natural and anthropogenic influences responsible for present and future changes to bay systems are the focus of Chapter 6. We conclude with a summary of management issues and the difficulties in balancing demands for access and development while protecting water quality (Chapter 7).

Howes, B.L., T. Williams, and M. Rasmussen. 1999. Baywatchers II: Nutrient Related Water Quality of Buzzards Bay Embayments: A Synthesis of Baywatchers Monitoring 1992-1998. Coalition for Buzzards Bay. New Bedford, MA.

Abstract: In 1984, Buzzards Bay became one of four estuaries making up the National Estuary Program. In 1985, the Bay was designated an "Estuary of National Significance" by Congress and the Buzzards Bay Project was established to develop strategies for protecting the Bay's natural resources. A Comprehensive Conservation and Management Plan (CCMP) for Buzzards Bay was developed by the Buzzards Bay Project with support from USEPA and the Massachusetts Executive Office of Environmental Affairs which focused on three priority issues: closure of shellfish beds, contamination of fish and shellfish by toxic metals and organic compounds, and potential water quality degradation from excessive nutrient loading. The Project worked closely with regional scientists and the Coalition for Buzzards Bay in the development and continued implementation of the Plan. The Plan's focus on watershed nutrient loading helped to form a collaborative effort to assess the nutrient related health of the Bay, which became the Water Quality Monitoring Program, "Baywatchers."

Buzzards Bay generally runs northeast to southwest, encompassed primarily by the Massachusetts mainland to the west, Cape Cod to the east and northeast, and the Elizabeth Islands (Cuttyhunk, Nashawena, Pasque, Penikese and Naushon) to the southeast. The bay is approximately 27 miles long and 7 miles wide and is relatively shallow with a mean depth of 11 meters. The bay was formed as a result of the last ice age and the retreat of the glaciers (about 16,000-18,000 years ago), and the geologic processes generated lasting differences in the watersheds on the western versus the eastern shores. The western shore is physically more irregular, creating more embayments than on the eastern shore. This undulating coast creates about 202 miles of waterfront, including 11 miles of public beaches.

Huber, M. 1990. Aspects of Reproductive Ecology of *Menidia menidia* (L.) and *Menidia beryllina* (Cope) in Southern Rhode Island. University of Rhode Island.

Abstract: Two atherinid fishes, *Menidia menidia* and *M. beryllina*, were compared with respect to the allocation of resources into growth and reproduction as they prepare for spawning. Such differences may result in different growth and maturation tactics that allow these species to coexist while sharing similar resources. Dry weights of gonads, livers, and eviscerated carcasses of both species collected from two southern Rhode Island estuaries during the spring and summer were determined.

During the spring, *M. menidia* males and females showed little change in average carcass weight. Male liver weight reached a peak in March and gradually declined thereafter. Female liver weight increased in March and remained high for as long as they remained in the upper estuary. Significant increases in male and female gonad weights occurred in March and April, followed by decreases in May and June. It appears that before the winter *M. menidia* reach a size at which reproduction can occur and apparently allocate almost all resources ingested in the spring into gonadal development (as well as liver enlargement by females).

No weight increase of any of the specified compartments occurred in *M. beryllina* until early May when growth of somatic and reproductive tissues began simultaneously. In contrast to *M. menidia, M. beryllina* accomplished rapid somatic growth while maturation and reproduction occurred.

Differences in the amount of resources invested were observed between and among species and sexes. Females of both species exhibited a larger investment of energy into livers and gonads than males. Female gonadosomatic indices are very similar for both species, with *M. beryllina* usually reaching values slightly higher than *M. menidia*. While hepatosomatic indices for males of both species were very similar, *M. menidia* male gonadosomatic indices reached values about 115% larger than those achieved by *M. beryllina* males.

A comparison of resource allocation between the two estuaries in 1990 indicated basically no differences

between *M. menidia* at each site. For *M. beryllina*, however, there was a delay in growth and maturation in one of the estuaries, with peak gonadosomatic indices occurring approximately a month apart.

The timing and duration of the spawning interval of *M. beryllina* in 1989 was determined from otolith daily ring counts. Most spawning in the upper Pettaquamscutt River occurred for a period of 14 days from May 16 to May 30 while spawning in upper Point Judith Pond occurred for a period of 39 days from June 9 to July 17. The reasons for these differences in spawning times at each estuary are presently unknown.

Huber, M. 1995. Environmental Control of Reproduction in an Estuarine Fish, *Menidia beryllina* (Cope), in Rhode Island (Photoperiod). Ph.D. Dissertation. University of Rhode Island. Kingston, RI. 167 pp.

Abstract: Menidia beryllina is an annual species that inhabits coastal estuaries along the east coast of the United States from Cape Cod to the Gulf of Mexico. In Rhode Island the onset of gonadal maturation begins consistently in late April/early May. To determine the effects of photoperiod and temperature on the regulation of the onset of maturation, fish in the laboratory were exposed to various treatments of varying photoperiod and temperature regimes. Fish exposed to low temperature showed no changes. Those in low photoperiod treatments initiated maturation but were not able to complete the process. Those exposed to the intermediate photoperiod matured and spawned for a short period of time before the gonads began to regress while those exposed to high photoperiods matured and spawned large numbers of eggs. The low and intermediate photoperiod exposures also resulted in accumulation of reserves in the liver, a response observed in field fish collected in the fall.

In order to determine the pattern of allocation of food resources into gonadal and somatic tissues during maturation and spawning two laboratory feeding experiments were conducted. Fish in the first experiment did not receive appropriate maturation cues and thus were not synchronized in stages of maturation and allocated little to gonads. Those in the second experiment received appropriate maturation cues that resulted in substantial allocation to gonads and in precise synchrony of stages of maturity among treatments. With decreased ration, females in the first experiment allocated proportionally less into gonads whereas those in the second experiment allocated proportionally more.

In order to determine the relationship between spawning of Menidia beryllina and the occurrence of zooplankton peaks, populations in two estuaries showing a displacement in their spawning times were studied. Sampling complications at one of the estuaries precluded determination of the relationships sought. Nevertheless, the sampling conducted in the other estuary indicated that spawning did not appear to be affected by zooplankton peaks and that food consumption is significantly higher upon the beginning of maturation. The results of this study were not able to elucidate if food abundance is an important factor explaining the delay in spawning observed.

Hubertz, J.M. 1995. Variation of measured meteorologic and oceanic variables off the U.S. Atlantic coast: 1980-1994. Pages 45-57 4th International Workshop on Wave Hindcasting and Forecasting. Banff, Alberta, Canada, October 16-20 (1995), Environment Canada.

Abstract: The National Data Buoy Center, within the National Weather Service of the National Oceanic and Atmospheric Administration, operates buoys off the coasts of the United States from which atmospheric and oceanic measurements are made. This program began in the mid-1970s with only a few buoys in the Atlantic, Pacific, and Gulf of Mexico measuring meteorological variables. More buoys were gradually added in the 1980s and 1990s, and measurements became more sophisticated.

This study examines data from five buoys off the Atlantic Coast for the 15-year period from 1980 to 1994. These buoys are identified as 44011, 44004, 41001, 41002, and 41006. Their locations are shown in Figure 1. The data from these buoys were chosen for study because of location along the coast in deep water and long period of record for both meteorological and oceanic data.

Huff, L.C. 1969. CW Phase Measurements across Block Island Sound. USL Technical Memorandum No. 2213-279-68. U. S. Navy Underwater Sound Laboratory. New London, CT.

Abstract: A shallow water acoustic range 40 meters deep has been investigated at a range of 33 kilometers to determine the magnitude and temporal character of phase variations in the received signals. Variations sinusoidal in nature with peak-to-peak amplitude on the order of 20 cycles of the acoustic carrier were observed at the tidal periods. The phase of the received signal retarded during flood tide and advanced during ebb tide. Carrier frequencies of 1700 and 1704 Hz were employed in separate experiments conducted under mean sound velocities of 1470 and 1450 meters per sec, respectively. The results of both tests demonstrate that there is a temporal scale of phase variability closely related to the tidal phenomena.

Hughes, J.B. 1999. Cytological–cytogenetic Analyses of Winter Flounder Embryos Collected from the Benthos at the Barge *North Cape* Oil Spill. Marine Pollution Bulletin. 38(1):30-35.

Abstract: The oil barge North Cape ran aground on Moonstone Beach in Rhode Island on January 19, 1996, spilling 828000 gallons (U.S.) of a combination of diesel and home heating oils. Samples of winter flounder (Pleuronectes americanus) embryos were collected from salt ponds in the area of the spill using an epibenthic sled. An examination of the field-sampled embryos based on gross morphology, levels of moribund embryos, mitotic index, and chromosomal anomalies found that a significant number exhibited high levels of one or more of these conditions when compared with flounder embryos raised under laboratory-controlled conditions. No chorion damage was noted in embryos collected from the field nor were there any significant findings of lordosis or scoliosis. The cumulative impact on winter flounder embryos of North Cape oil exposure was an estimated 51% reduction in the number of embryos surviving to the larval stage.

Hughes, J.E. 1996. Size-dependent, Small-scale Dispersion of the Capitellid Polychaete, *Mediomastus ambiseta*. Journal of Marine Research. 54:915-937.

Abstract: Small-scale spatial pattern of M. ambiseta was investigated in sediments of central Narragansett Bay USA. Analysis revealed a trend of decreasing patchiness and intensity of aggregation with increasing body size of M. ambiseta during the primary period of settlement and population growth. M. ambiseta influenced the small-scale distribution and concentration of organic matter and bacteria in surficial sediment. Studies showed that this species creates two distinct sediment habitats through its sediment reworking activities.

Hurlburt, S. and M. Spaulding. 1977. Application of a Two-dimensional Hydrodynamic and Constituent Transport Model to Block Island Sound-Rhode Island Sound-Buzzards Bay Complex. Can. Dep. Environ. Mar. Sci. Dir., Manuscr. Rep. Ser. 43:83-90.

Hurtt, A.C. 1978. The Distribution of Hydrocarbons in Narragansett Bay Sediment Cores. URI.

Abstract: To provide more extensive data on sedimentary hydrocarbons present in Narragansett Bay, twenty cores were collected and analyzed. The results confirmed some expected trends, and also revealed some unusual findings. There was a general decrease in hydrocarbon concentration with increasing depth in the sediment cores. However, the East and West Passages of the Bay were quantitatively different. A number of stations in the East Passage showed increasing hydrocarbon concentrations with depth in the cores. From available information, the exact cause of this phenomenon cannot be determined. However, the observed contamination could be due to one or a combination of the following: past Navy activities or unreported spills in that area, previous inputs from the Taunton River, or other factors.

Organic carbon, total hydrocarbon/organic carbon percentages, the concentration of a biogenic hydrocarbon (HC_{344}), and the percentage of HC_{344}/organic carbon in surface sediments were measured and/or calculated to further the understanding of the transport of these substances throughout the Bay. The results indicate that organic carbon generally decreases with distance from the Providence River and with depth in the

cores. However, some notable exceptions were found in the East Passage, which corresponded to the high hydrocarbon concentrations with depth in these cores. There was a high correlation of total hydrocarbons with organic carbon for surface sediments throughout the Bay. Also, the HC/OC percentages generally decreased with increasing distance from the Providence River and with depth in the cores, again with some exceptions in the East Passage. A high correlation of the HC_{344}/OC percentage in surface sediments with distance down the Bay in the West Passage was observed while there was poor correlation in the East Passage. Finally, there was a poor correlation of HC_{344} vs. the organic carbon in surface sediments for both the East and West Passages.

The information from this study indicates that the main source of hydrocarbons in Narragansett Bay sediments is the Providence River, and that these compounds are probably introduced into the Bay proper via the tidal currents. Previous work has shown that the major source of hydrocarbons in the River is municipal sewage effluents (Van Vleet and Quinn, 1978). These workers have estimated also that approximately 51,000 tons hydrocarbons/year enter U.S. coastal waters via sewage effluents while approximately 25,000 tons/year enter through spills. The present study further substantiates that municipal wastewater treatment plants represent a significant source of oil pollution to estuarine waters. Seemingly the most efficient way of reducing the input of oil into (and out of) sewage treatment plants would be to institute an oil recycling program. This is becoming more economically feasible with the increasing price of oil.

Huston, M.A. 1994. Biological Diversity: The Coexistence of Species on Changing Landscapes. Cambridge University Press. Cambridge.

Abstract: Table of Contents received: (1) General Patterns of Species Diversity; (2) The Assessment of Species Diversity; (3) Equilibrium Processes and Landscape-scale Diversity; (4) Non-equilibrium Processes and Local Diversity; (5) Diversity within Populations; (6) The Structure of Communities and Ecosystems; (7) Landscape Patterns: Disturbance and Diversity; (8) Landscape Patterns: Succession and Temporal Change; (9) Landscape Patterns: Gradients and Donation; (10) Concluding Comments: The Economics of Biological Diversity.

Ichiye, T. 1967. Tidal Variation of Hydrography of Block Island Sound Observed in August 1965. Lamont Geological Observatory. Palisades, NY.

Abstract: The hydrographic survey of Block Island Sound was carried out on August 17th to the 19th, 1965 on board the R/V UCONN of the University of Connecticut and the R/V CONRAD, JR. of Lamont Geological Observatory. The two ships made several runs of two triangular circuits of hydrographic stations. The temperature and salinity data at each section are arranged according to the tidal stage at the Race. The readings of the portable salinometers are compared with the bucket temperatures, BT data and the laboratory salinometer data. The fluctuations of temperature and salinity at different tidal stages are maximum at the deep layer of the central portion of the southern channel. The composite T-S diagrams of the whole stations indicate that the water temperature ranges from 10° C to 23° C and the salinity ranges from 30‰ to 32‰. The water from Newport Bight has low temperature (less than 18° C) and low salinity (less than 30.5‰) while the water of the subarctic origin has the lowest temperature (less than 14° C) and the highest salinity (more than 31.5‰). The former flows into the sound through the eastern channel during the flood and leaves the sound through the southern channel during the ebb, while the latter enters through the central part of the southern channel during the flood, moves to the northwest and leaves the sound along the northern coast during the ebb. A simple mathematical model on mixing of different water masses in the sound is proposed on the basis of the Lagrangian method for treating mixing along a trajectory of each water mass.

Incze, L.S., R.A. Wahle, and J.S. Cobb. 1997. Quantitative Relationships Between Postlarval Production and Benthic Recruitment in Lobsters, *Homarus americanus*. Marine & Freshwater Research. 48(8):729-743.

Abstract: Relationships between lobster postlarval supply and benthic recruitment were evaluated within

and between oceanographically distinct segments of the range of the American lobster. Postlarvae (PL) were sampled by neuston nets in western Rhode Island Sound and the western Gulf of Maine, USA, from June to September 1989-95. Benthic lobsters were sampled in sublittoral cobble habitat by using a diver-operated airlift at the end of the settlement season. Average annual recruitment densities of young-of-year (YOY) lobsters ranged from 0.3 to 1.7 m^{-2}). YOY recruitment was positively correlated between areas. Integrated seasonal abundance of postlarvae was often much greater in Rhode Island than Maine, but production estimates (PL 1000 m^{-2} $season^{-1}$), calculated from molt cycle stages and temperature-dependent growth rates, differed by a factor of <0.5. PL production was positively correlated between areas and explained ≥ 81% of the annual variation in recruitment in each area and 90% for the two areas combined. In Maine, among-site differences in YOY recruitment persisted for a year after settlement and then began to lessen, at least in part because larger individuals moved into areas of initially lower recruitment.

Intergovernmental Policy Analysis Program, University of Rhode Island. 1989. The Commercial Fishing Industry in Rhode Island: An Inventory, Analysis and Assessment Prepared for the Rhode Island Port Authority and Economic Development Corporation. Intergovernmental Policy Analysis Program, University of Rhode Island. Kingston, RI.

Abstract: The Intergovernmental Policy Analysis Program of the University of Rhode Island undertook this study of the Rhode Island commercial fishing industry with two major goals in mind: a) to establish base-line data to determine the existing conditions of the industry, and for use in future tracking of industry trends; b) to define those parameters impacting the industry's performance as it relates to the State's overall economy. A summary of the study's findings is presented below.

The study found that Rhode Island's commercial fishing industry outperformed the New England regional industry during the decade of the 1980's. The Rhode Island commercial fishing industry showed an increase in total landings of 24 percent in the time period from 1980 to 1987, in sharp contrast to New England's general decline on landings of 31 percent. The corresponding increase in value of that harvest was a 68 percent increase for Rhode Island, from $46 million to $77.4 million. The total value of New England's harvest in this time increased by 57 percent, a much slower rate of growth than that of Rhode Island.

James-Pirri, M.J. and J.S. Cobb. 1997. Growth Rates of Planktonic and Newly Settled American Lobsters *Homarus americanus*. Marine Ecology Progress Series. 160:233-240.

Abstract: Growth rates, as estimated by the RNA:DNA ratio, were determined for planktonic postlarvae and for recaptured and wild newly settled benthic stages (fifth and sixth instars) of the American lobster Homarus americanus. The mean growth rate of planktonic postlarvae in 1994 was 0.522 plus or minus 0.247 mg protein/d. This was significantly higher than planktonic growth rates observed in 1991 (0.449 plus or minus 0.121 mg protein/d) but not in 1992 (0.460 plus or minus 0.144 mg protein/d). The percentage of poorly nourished planktonic postlarvae, those with growth rates 0.220 mg protein/d, ranged from 3 to 13% in 1991, 1992 and 1994 and was similar to that observed in previous years (1988 to 1990). Newly settled lobsters had significantly lower mean growth rates (0.223 plus or minus 0.180 mg protein/d) than planktonic postlarvae. Recaptured lobsters originating from wild stock had significantly higher growth rates than those originating from laboratory stock (0.281 plus or minus 0.176 vs. 0.085 plus or minus 0.078 mg protein/d, respectively). Laboratory rearing effects (lowered growth rates) appeared to persist even after 1 wk in the field. The differences in the growth rates between planktonic and benthic phase lobsters may be evidence of a trade-off between slow growth due to decreased food ingestion and potential increased vulnerability to predation when actively foraging.

Jeffries, H.P. 1994. The Impacts of Warming Climate on Fish Populations. Maritimes. 37(1):12-15.

Abstract: In the Narragansett Bay-Rhode Island Sound area, there is an unmistakable connection between warmer winters and collapse of the winter flounder (*Pleuronectes americanus*) population. The collapse has set the stage for reorganization of the entire large-animal bottom community. This is based on what is

probably the world's best long-term data set on nearshore and estuarine fish abundance. Changes in the fish community of Narragansett Bay are well documented and include comparisons with changes occurring at larger scales on the continental shelf.

Jeffries, H.P. and W.C. Johnson. 1974. Seasonal Distribution of Bottom Fishes in the Narragansett Bay Area: Seven Year Variations in the Abundance of Winter Flounder (*Pseudopleuronectes americanus*). Journal of the Fisheries Research Board of Canada. 31:1057-1066.

Abstract: Weekly bottom trawl samples taken in Narragansett Bay and Rhode Island Sound from January 1966 through December 1972 showed patterns of occurrence within a diverse assemblage of migratory and resident stocks. Relative abundance of winter flounder (*Pseudopleuronectes americanus*), the commonest species in the Bay, appeared to be associated with climatic trends but not with fishing pressure. Catch decreased 78% from 1968 to 1972. Average temperature during 30-mo periods, the time required for flounder to reach catchable size, explained 76% of variation in abundance through the study. Annual abundance in the Bay is also reflected 2-3 yr later in the commercial catch. A speculative explanation for control of the population in an estuarine nursery is developed, based on subtle climatic trends whose effects have been magnified many times over by competitive processes among migratory populations.

The sand flounder (*Scophthalmus aquosus*), second in general abundance, varied far less than the winter flounder. Catches of the lobster (*Homarus americanus*) and winter flounder were directly related, both on a monthly as well as yearly basis. The remaining species of numerical importance appeared to avoid peak abundances of one another in the Bay and Sound; rarely did seasonal maxima of two or more species occur during the same month.

Jeffries, H.P. and M. Terceiro. 1985. Cycle of Changing Abundances in the Fishes of the Narragansett Bay Area. Marine Ecology Progress Series. 25:239-244.

Abstract: Winter flounder *Pseudopleuronectes americanus* in Narragansett Bay, Rhode Island, reached peak abundance in 1968 and then went into an 8 yr decline, dropping to 1/7 of its former population size, as estimated from weekly tows by otter trawl. Meanwhile a succession of species increased offshore: red hake *Urophycis chuss* became the commercial dominant in 1973, the ocean pout *Macrozoarces americanus* and silver hake *Merluccius bilinearis* in 1974, but among these coastal migrants only scup *Stenotomus chrysops* entered the bay in substantial numbers. By 1976 scup had increased 25 times in the bay, numerically overshadowing the flounder's 8 yr decline. A year later, founder began to recover; and after 3 yr (1979) it had achieved its former abundance, only to decrease 58% over the next 3 yr (1982). Throughout the entire sampling period, migrants and residents bore close inverse relations in bay and sound. Thus, when the bay's flounder population dropped to 1/3 of its 1968 maximum, migrants dominated the sound's fishes, possibly having been attracted to the immediate area by foods not utilized by the dwindling flounder population during its spring-fall migration from estuarine to coastal waters. These patterns appeared to be initiated by warming and cooling trends to subtle that the effect may have been mediated by predation on larvae at metamorphosis, a process eventually influencing the entire complex of benthic fishes in the Narragansett Bay area.

Johnson, L.L., C.M. Stehr, O.P. Olson, M.S. Myers, S.M. Pierce, B.B. McCain, and U. Varanasi. 1992. Fish Histopathology and Relationships Between Lesions and Chemical Contaminants (1987-89). NOAA Technical Memorandum NMFS-NWFSC-4. National Benthic Surveillance Project: Northeast Coast. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 9 pp: http://www.nwfsc.noaa.gov/pubs/tm/tm4/techmem4.htm.

Abstract: This report presents and interprets the results of pathology studies conducted on winter flounder (*Pleuronectes americanus*) between 1987 and 1989 in conjunction with NOAA's National Status and Trends (NS&T) Program. In these studies, a variety of potentially contaminant-associated disease conditions were monitored in winter flounder collected from 22 Northeast Coast sites, and the relationship between disease occurrence and levels of organic chemical contaminants in sediments, stomach contents,

and tissues was examined. Sampling was conducted primarily in spring of 1988 and 1989 (Cycles 5 and 6) as part of the National Benthic Surveillance Project (NBSP) of the NS&T Program, but to provide a more comprehensive view of pathological conditions in winter flounder from the Northeast Coast, data on winter flounder collected in Long Island Sound during 1987 and in Boston Harbor and adjacent embayments during the winter of 1988 were also included in this memorandum. In the three studies combined, a total of more than 1,500 fish were examined.

Embayments sampled included Salem Harbor, Boston Harbor, Massachusetts Bay, New Bedford Harbor, and Buzzards Bay in Massachusetts; Narragansett Bay in Rhode Island; Niantic Bay in Connecticut; several sites within Long Island Sound including New Haven, Norwalk, Bridgeport, and Rocky Point in Connecticut and Lloyd Point in New York; and Raritan Bay and Great Bay in New Jersey. The levels and types of chemical contaminants present in sediments from sampling sites within these embayments differed substantially. Among the most heavily contaminated sites were Mystic River and Quincy Bay in Boston Harbor, and Gravesend, West Reach, and East Reach sites in Raritan Bay. Sediments from these sites had elevated levels of all or most of the contaminants measured in this study, including aromatic hydrocarbons (AHs), polychlorinated biphenyls (PCBs), DDTs (DDT and its derivatives), and chlordanes. The New Bedford Harbor sampling site had very high concentrations of PCBs in sediments, but relatively low concentrations of other classes of contaminants. Lowest concentrations of nearly all classes of contaminants were found at the Plymouth Entrance site in Massachusetts Bay and at the Rocky Point site in Long Island Sound. The Rocky Point site served as a reference site for analyses of intersite differences in lesion prevalences. Detailed information on concentrations of contaminants in sediments from these sampling sites will be reported in a forthcoming Technical Memorandum. (Record ID 194)

Johnson, L.L., J.E. Stein, T.K. Collier, E. Casillas, B. McCain, and U. Varanasi. 1992. Bioindicators of Contaminant Exposure, Liver Pathology, and Reproductive Development in Prespawning Female Winter Flounder (*Pseudopleuronectes americanus*) from Urban and Nonurban Estuaries on the Northeast Atlantic Coast. NOAA Technical Memorandum NMFS-NWFSC-1. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Seattle, WA. 12 pp: http://www.nwfsc.noaa.gov/pubs/tm/tm1/tm1.htm.

Abstract: Relationships between liver pathology and ovarian development, and exposure to xenobiotic compounds were evaluated in prespawning female winter flounder sampled from 11 sites on the Northeast coast of the United States during the 1988 and 1989 spawning seasons. The following parameters associated with ovarian development were measured: ovarian developmental state, ovarian atresia, gonadosomatic index, plasma estradiol, fecundity, and egg weight. Contaminant exposure was assessed by measuring concentrations of fluorescent aromatic compounds in the bile; hepatic aryl hydrocarbon hydroxylase activity; concentration of polychlorinated biphenyls in lever, ovary, and brain; and levels of xenobiotic-DNA adducts in liver tissue.

Johnson, R.G. 1974. Particulate Matter at the Sediment-Water Interface in Coastal Environments. Journal of Marine Research. 32:313-329.

Abstract: A microscopic study was made of marine sediments to identify the kinds of materials present at the sediment-water interface and to describe these materials from a biological point of view. Fifty-two samples were collected at 26 stations in the vicinity of Woods Hole, Massachusetts. A total of 42 particle species was recognized. Up to 69% of the quartz particles were encrusted with organic matter. All of the samples contained flocculent organic-mineral aggregates in amounts varying from 13 to 71% particle abundance. Nearly all of the clay and silt size particles were incorporated in an organic matrix. The organic-mineral aggregates probably are the products of the recycling of organic matter by deposit feeders. An average of sixty-one percent of the particles examined in samples of surficial sediments were potential food particles. The standard methods of describing sediments are inadequate for understanding animal-sediment relations and geological processes. Encrusted particles and organic-mineral aggregates must have different sedimentological properties than clean or free mineral particles. Thus, while the bulk analysis of a sediment may reveal only a few percent organic matter, that may be one of its most important properties.

Juinio, M.A.R. 1991. Feeding Ecology of the Postlarval Lobster *Homarus americanus*. Ph.D Dissertation. Page 55-. University of Rhode Island. 200 pp.

Abstract: To gain insight into the importance of food limitation on the recruitment of postlarval Homarus americanus, the natural diet and feeding habits of postlarvae were determined. Secondly, the usefulness of RNA:DNA ratios as an indicator of the nutritional state of postlarval lobsters was investigated in the laboratory. A growth model based on the relationship of RNA:DNA ratios, temperature and protein growth rates in the laboratory was developed and used to estimate the recent growth of postlarval lobsters collected from nearshore waters in Block Island Sound, Rhode Island.

The foregut contents of postlarval lobsters collected during diel neuston sampling indicated a predominantly carnivorous feeding habit. The disproportionate frequency of occurrence of large copepod species and decapod larvae in the guts relative to their abundance in the plankton suggested preference for larger sized prey. Completely empty guts were rare indicating that postlarvae fed successfully throughout the day. However, the higher incidence of guts with newly ingested prey at night suggested higher feeding activity during this time.

In the laboratory, three replicate batches of postlarval lobsters were individually maintained under nine treatments in a 3 x 3 factorial combination of temperature and feeding regimes. The effects of food availability and temperature on total dry weight, protein, RNA, DNA (mg individual$\sp{-1}$) and RNA:DNA ratios over the molt cycle during the postlarval instar were determined. Patterns in cell growth based on protein:DNA ratios and total DNA, and changes in total protein and dry weight over the molt cycle varied among animals reared under different feeding regimes. RNA:DNA ratios varied among molt stages and was inversely related to temperature. This ratio was positively related to the feeding history of individuals only in molt stages C to D$\sb1$.

Based on the estimated individual growth rates, the majority of field animals were well-nourished. There was no correlation between average growth rates and zooplankton biomass. Results showed no evidence that food limitation, resulting in starvation or extended duration of the instars, is a significant factor contributing to the observed interannual variability of postlarval densities at the nearshore areas of Block Island Sound during 1988-1990.

Juinio, M.A.R. and J.S. Cobb. 1994. Estimation of Recent Growth of Field-caught Postlarval American Lobsters, *Homarus americanus*, from RNA:DNA Ratios. Canadian Journal of Fisheries and Aquatic Sciences. 51(2):286-294.

Abstract: We developed a growth model for the postlarvae of the American lobster, Homarus americanus, using the relationship of RNA:DNA ratios, temperature, and growth rates during postmolt through early premolt of laboratory-reared postlarval lobsters. The model was used to estimate individual growth rates of 385 postlarval lobsters in molt stages C and D sub(0), collected at two sites in Block Island Sound over three years, 1988-90. The incidence of poorly nourished postlarval lobsters (individuals with growth rates <0.22 mg protein multiplied by d super(-1)) was less than 10% of the total samples in each year. We found no evidence that food limitation, resulting in starvation or prolonged duration of the postlarval instar, was a significant factor contributing to the observed interannual variability of postlarval densities.

Juinio, M.A.R. and J.S. Cobb. 1992. Natural Diet and Feeding Habits of the Postlarval Lobster *Homarus americanus*. Marine Ecology Progress Series. 85(1-2):83-91.

Abstract: Postlarval Homarus americanus were collected from Block Island Sound, Rhode Island, USA, during 5 diel neuston sampling periods in summer 1988 and 1989. The foregut contents of the postlarvae were determined and compared with the relative abundances of potential prey groups in the plankton. Nine taxonomic prey groups were identified in the gut contents (N = 802). The frequent occurrence of copepods, decapod larvae, fish eggs and insect parts indicates a predominantly carnivorous feeding habit. Furthermore, the disproportionate frequency of occurrence of large copepod species and decapod larvae in the guts relative to their densities in the plankton suggests a preference for larger sized prey. Contrary to

expectations, the mean gut fullness and condition of gut contents of individuals at different molt stages were not significantly different. Likewise, there was no significant difference in the incidence of guts with newly ingested prey between postlarvae in the premolt stages and those in the post and intermolt stages.

Juinio, M.A.R., J.S. Cobb, D. Bengtson, and M. Johnson. 1992. Changes in Nucleic Acids over the Molt Cycle in Relation to Food Availability and Temperature in *Homarus americanus* Postlarvae. Marine Biology. 114(1):1-10.

Abstract: Postlarval lobsters Homarus americanus hatched from three females collected in 1989 from Block Island Sound, Rhode Island were reared individually in the laboratory under nine treatment combinations of temperature (15, 18 and 21 degree C) and feeding (starved, low ration and full ration). Total RNA, DNA (mg/ind.), RNA:DNA ratios and molt stage were determined for individuals sampled at daily intervals. Post-larval lobsters had high resistance to starvation. A majority of the lobsters survived 12 d of food deprivation, with some surviving up to 24-29 d. During starvation, cell biomass (estimated from protein:DNA) decreased to a minimum size, whereas cell number (based on total DNA) was generally conserved. The molt cycle was arrested at molt stage C in the starved postlarvae. Instar duration was inversely related to temperature. However, the duration of the postlarval instar did not differ between the low and full ration treatments. Uncoupling of cell growth and the molt cycle was evident in the full and low ration treatments.

Kadri, J. 1991. A Raw Deal: Combined Sewer Overflow Pollution in Narragansett Bay. RIU-W-90-003. Pages 43-58 In: Rice, M.A., M. Grady, and M.L. Schwartz. (Eds.), Proceedings of the First Rhode Island Shellfisheries Conference.

Abstract: Combined sewer overflows (CSOs) have long been identified as chronic pollution sources to Narragansett Bay. This paper examines the history of CSO pollution--its environmental effects, economic impacts, and legal implications--and summarizes technical solutions and local CSO abatement efforts.

Kanabis, W.G. 1968. BIFI Propagation Tests of 30 January 1968. U.S. Navy Underwater Sound Laboratory. New London, CT.

Abstract: This memorandum deals with an acoustic test conducted in Block Island Sound on 30 January 1968. The test is one of a series to be conducted monthly and is referred to as "Experiment 2" in reference (a). In this test, propagation loss over two acoustic paths were compared, using both CW pulses and explosives as sound sources. The results obtained are compared with those of a similar test conducted in August 1967.

Karnofsky, E.B., J. Atema, and R.H. Elgin. 1989. Natural Dynamics of Population Structure and Habitat Use of the Lobster, *Homarus americanus*, in a Shallow Cove. Biological Bulletin. 176(3):247-256.

Abstract: We report the results of a non-manipulative field study of the lobster, *Homarus americanus,* using long-term behavioral observations of marked individuals. We observed a freely mobile population in an open shallow cove habitat (50 m x 150 m) in Buzzards Bay, Massachusetts. Lobsters larger than 50 mm carapace length (CL) living in or entering the study site were marked individually (334 during the 19 month study). Without further manipulation, the animals were observed as long as they remained in the study site. Of the marked animals, 48% were transient, *i.e.*, seen only once.

The population was made up largely of subadults with a sex ratio of M:F = 1.8. The summer and fall resident population consisted of about 30 animals. Maximum residency was over 13 months. Half of the resident population, mostly small animals (50-59 mm CL), apparently overwintered in the site. A distinct peak in molting occurred both years in the spring at a water temperature of 15°C. Injured animals were seen frequently (26% of the population) including a high proportion of mature resident males missing claws. These results suggest that the shallow cove is used as a refuge for injured mature males.

Activity was strictly nocturnal with a peak 1-3 h after sunset and declining through the night. Activity levels were equal for both sexes. Overall activity was correlated with seasonal variations in water temperature (0-24°C). At times, activity was correlated more with molting (pre-molt activity peak) than with temperature. Behavioral interactions in this population are described in a companion paper (Karnofsky et al., 1989).

Katona, S.K., V.R. Rough, and D. Richardson. 1993. A Field Guide to the Whales and Seals from Cape Cod to Newfoundland. Volume 4th Edition, revised. Smithsonian Institution Press. Washington, D.C. 316.

Katona, S.K. and H.P. Whitehead. 1988. Are cetacea ecologically important? Oceanogr. Mar. Biol. Annu. Rev. 26:553-568.

Abstract: In undisturbed ecosystems, cetacean biomass is similar to that of other smaller size classes and cetaceans may be useful indicators of ecosystem health and productivity. Cetaceans are important in energy flux within marine and selected freshwater systems, but usually do not affect nutrient cycling to a significant degree. Cetacean carcasses provide important food source for terrestrial and benthic scavengers. Feeding gray whales disturb local benthic environments on a scale equivalent to major geological forces. Living cetaceans are colonized by a diverse fauna of commensal and parasitic invertebrates. Seabirds and some fishes benefit from feeding associations with cetaceans. Cetacean sounds are prominent in the ocean and could be useful as cues to other animals. Fishes and invertebrates do not show noticeable adaptations to cetacean predators, but cetaceans themselves display defensive adaptations against killer whales. Whaling has altered ecosystem structure in Antarctica and perhaps other places, and the whaling industry caused profound ecological effects, especially on some oceanic islands. Cetacean entanglement in fishing gear can harm local fisheries, but there is no concrete evidence that they harm fisheries in other ways. In some cases they may benefit fishermen by removing species that could compete for commercially harvestable fish.

Kearns, C.M., N.G. Hairston, Jr., and D.H. Kesler. 1996. Particle Transport by Benthic Invertebrates: Its Role in Egg Bank Dynamics. Hydrobiologia. 332(1):63-70.

Abstract: The ecological and evolutionary dynamics of zooplankton is in part a function of the numbers and ages of diapausing eggs hatching from aquatic sediments. Successful recruitment from this 'egg bank' must depend upon the eggs being present at or near the sediment surface. Often, however, zooplankton diapausing eggs are found as deep as 15 to 30 cm in the mud. Bioturbation may provide a mechanism for the regular return of buried eggs to the sediment surface. A substantial portion of the population of the copepod, Diaptomus sanguineus, living in Bullhead Pond, a small lake in Rhode Island, USA, is present as diapausing eggs. To study the role of bioturbation in egg-bank dynamics, we introduced polystyrene beads, the same size and specific gravity as copepod eggs, at two depths in large-diameter sediment chambers in the laboratory. Treatments included chambers with natural and reduced densities of benthos. Consistent with other studies, our results show that the joint activities of tubificid oligochaetes and chironomid larvae are responsible for bidirectional (up and down) transport of beads in the top 2 cm of the sediment. We observed no bead movement below this depth. Thus, eggs in the top two centimeters of sediment in this lake are exposed with some regularity to conditions that stimulate hatching at the sediment-water interface. In Bullhead Pond, these eggs have a mean age of 12.2 years (based on super(210)Pb-dating). Eggs buried more deeply will only be returned to the sediment surface by relatively rare, localized disturbances. This return of old eggs to the surface affects ecological and evolutionary dynamics in a complex way.

Keefe, M. and H.E. Winn. 1991. Chemosensory Attraction to Home Stream Water and Conspecifics by Native Brook Trout, *Salvelinus fontinalis*, from Two Southern New England Streams. Canadian Journal of Fisheries and Aquatic Sciences. 48(5):938-944.

Abstract: Behavioral preference tests were used to determine whether native brook trout, *Salvelinus fontinalis* , from two distinct populations could chemically discriminate home stream water and stock-

specific cues. Juveniles and adults from a local anadromous population demonstrated significant preferences for home stream water and conspecifics when these stimulants were paired with groundwater. However, these trout did not prefer home stream water when paired with water from an unfamiliar stream, nor chemical traces of sympatric juveniles when paired with those of allopatric juveniles. Juvenile brook trout from a freshwater resident population displayed the same chemosensory responses as the anadromous trout, although they demonstrated distinct seasonal differences in their behaviors. These landlocked juveniles also preferred home stream water when paired with water from an unfamiliar stream. Anosmic trout maintained significant preferences for home stream water and water conditioned by conspecifics over control water, indicating that olfaction is not necessary for these attractions. Gustation may have a role in the behavioral preferences of trout.

Keith, D.J., W.R. Davis, and J.F. Paul. 1991. Sediment Erodibility in Narragansett Bay, Rhode Island: A Method of Predicting Sediment Dynamics. NBP-91-69. Narragansett Bay Project. Providence, RI.

Abstract: The overall objective of this one year investigation was to study the entrainment potential of Narragansett Bay sediments in the context of understanding coastal sediment transport processes. The approach was to subject several sediment types in Narragansett Bay to a range of experimentally applied shear stresses and determine their erosiveness by developing quantitative relationships between shear stress, particle size data and water content. While developmental in nature, the models consistently identify areas within Narragansett Bay that have the highest and lowest potential for erodibility over the range of applied shear stresses. General the most easily erodible sediments are located in the upper Narragansett Bay, along the Providence River, the Bristol Harbor area, and in Mount Hope Bay. In comparison the sediments with the lowest potential for resuspension occur at the entrances to Narragansett Bay and Greenwich Bay.

Keller, A.A. and G. Klein-MacPhee. 2000. Impact of Elevated Temperature on the Growth, Survival, and Trophic Dynamics of Winter Flounder Larvae: A Mesocosm Study. Canadian Journal of Fisheries and Aquatic Sciences. 57(12):2382-2392.

Abstract: Winter flounder (Pseudopleuronectes americanus) is a dominant commercial fish in Narragansett Bay, Rhode Island and yet factors controlling its recruitment remain unclear. An experiment was conducted with six 13-m super(3) land based mesocosms (5 m deep) from February to April 1997 to address the impact of increased temperature (+3 degree C) on growth, survival, and trophic dynamics of winter flounder larvae. Objectives were to determine if warmer winter temperatures result in lower survival of winter flounder as a result of increased predator activity or if temperature-induced alterations in the food web result in greater food availability, perhaps leading to increased survival. Analyses of variance revealed significant or near-significant differences in phytoplankton and zooplankton abundance and biomass between warm and cool mesocosms. Winter flounder egg survival, percent hatch, time to hatch, and initial size were significantly greater in cool systems. Mortality rates were lower in cool systems and significantly related to the abundance of active predators. The cumulative impact of decreased survival of eggs and larvae in warm systems may partially explain the decline of winter flounder in Narragansett Bay, which has experienced elevated winter water temperatures in recent years.

Keller, A.A., G. Klein-MacPhee, and J. St. Onge-Burns. 1999. Abundance and Distribution of Ichthyoplankton in Narragansett Bay, Rhode Island, 1989-1990. Estuaries. 22(1):149-163.

Abstract: An ichthyoplankton survey (18 stations in seven sampling sectors) was conducted in Narragansett Bay in 1990 to provide information on abundance, distribution, and seasonal occurrence of eggs and larvae of estuarine fishes, including seasonal migrants. An additional goal was to examine changes in species composition, abundance, and distribution occurring since the last baywide survey in 1972-73. The taxonomic composition of eggs and larvae in 1990 (41 species in 25 families from 684 plankton samples) and in 1972-73 (43 species in 28 families from 6900 samples) was similar. Maximum abundance of fish eggs occurred in June and larvae in July, minimum abundance in September to February. Species diversity was greatest in May-July and lowest during January in both surveys. However, egg and larval densities in 1990 were considerably lower than in 1972-73. Bay anchovy, tautog, and cunner

accounted for 86% of the eggs and 87% of the larvae in the bay in 1990. These three species accounted for only 55% of the eggs and 51% of the larvae in 1972-73, with menhaden accounting for another 18% of the eggs and 34% of the larvae. Searobins, scup, and butterfish eggs were common in 1973 (19%) but rare in 1990 (2%). Ichthyoplankton abundance for several of the most abundant species was significantly lower ($p<0.05$) in the Providence River, upper bay, and Greenwich Bay in 1990 than in 1972-73. Density of fish eggs and larvae in the lower portions of the bay was lower in 1990 for some species but not others. Distribution data suggested a general down-bay shift in density in 1990.

Keller, A.A., C.A. Oviatt, H.A. Walker, and J.D. Hawk. 1999. Predicted Impacts of Elevated Temperature on the Magnitude of the Winter-Spring Phytoplankton Bloom in Temperate Coastal Waters: A Mesocosm Study. Limnology and Oceanography. 44(2):344-356.

Kelts, L. 1971. The Survival of *Nereis succunea* (Annelida, Polychaetes) Exposed to Different Temperature and Salinity Combinations with Reference to its Distribution in a Polluted Estuary. M.S. Thesis. Southern Massachusetts University. North Dartmouth, MA. 41 pp.

Kelz, R.C. 1992. Benthic Respiration and Production in the Pettaquamscutt River Estuary and Narragansett Bay. University of Rhode Island.

Abstract: *In situ* measurements of sediment oxygen demand (SOD) and gross sediment oxygen production (GSOP) by benthic microflora using dark and light stirred chambers were made at five sites in the Pettaquamscutt River Estuary, Rhode Island from October 1990 to August 1991. In addition, measurements of SOD were made in Narragansett Bay using identical methods and compared to previous *in situ* measurements. In the Pettaquamscutt River Estuary, annual area-weighted benthic metabolism and production by benthic microflora of 198 ± 24 g C·m¯¸·yr¯ą and 93 ± 34 g C·m¯¸·yr¯ą, respectively, have been estimated assuming respiratory and photosynthetic quotients of one. The ranges reported are propagated analytical uncertainties. Based on these estimates, the benthos was a net consumer of 105 ± 41 g C·m¯¸·yr¯ą. Annual SOD was highest near the head of the estuary and, with one exception, decreased downstream to lowest values near the mouth of the estuary. Annual GSOP was not significantly different at four of the five study sites so that no upstream or downstream trends were apparent. Sediments at all five sites were net annual consumers of energy. The excess of respiration over microfloral production tended to increase upstream. Net oxygen exchange across the sediment-water interface was strongly seasonal at all sites. At three sites in the lower estuary daily oxygen production was sufficient to meet daily oxygen demand during the winter months. At all other times and locations daily sediment oxygen demand exceeded daily production. Annual benthic metabolism in the oxygenated Pettaquamscutt River Estuary appears to be 13 to 44% higher than annual benthic metabolism in Narragansett Bay and suggests that there is a larger annual organic input to the River benthos than the Bay benthos. The winter-spring relationship between SOD and bottom water temperature in the Pettaquamscutt River is strongly logarithmic while there is evidence for an exponential relationship in Narragansett Bay. The proportion of organic input supplied by macrophyte detritus and benthic primary production to the Pettaquamscutt River benthos is probably much larger than in Narragansett Bay and may be the principal reason for the observed relationships between SOD and bottom water temperature in the respective systems.

Kendall, A. W., Jr. 1975. Patterns of Larval Fish Distributions in the Middle Atlantic Bight. In: Manowitz, B., Ed. Effects of Energy-Related Activities on the Atlantic Continental Shelf. Upton, NY: Brookhaven National Lab. p 127-45.

Abstract: In this paper I will briefly describe the early life history of marine fishes, explain the utility of studying young stages of fish relative to fisheries and oceanographic problems, and illustrate the present state of knowledge of ichthyoplankton studies in the Northwest Atlantic Ocean. With this background, needs for future studies, particularly in relation to man's activities in the Middle Atlantic Bight, will be evident.

Kendall, A.W., Jr. and L.A. Walford. 1979. Sources and Distribution of Bluefish, *Pomatomus saltatrix*, Larvae and Juveniles off the East Coast of the United States. Fishery Bulletin. 77(1):213-227.

Abstract: Larval bluefish are found offshore somewhere between Cape Cod, Mass., and Palm Beach, Fla., during every season of the year. However, there appear to be two main spawning concentrations—one during spring near the western edge of the Gulf Stream in the South Atlantic Bight and the other during summer over the continental shelf of the Middle Atlantic Bight. Larvae complete development near the surface; juveniles are strongly associated with the surface. Juveniles from the spring spawning remain at sea and are carried northward past Cape Hatteras, N.C., above the edge of the continental shelf. As surface shelf water warms, they move shoreward to spend the summer in estuaries of the Middle Atlantic Bight. Bluefish spawned in summer remain at sea as juveniles or enter estuaries briefly in late summer. In fall, as the water cools, the juveniles move southward out of the Middle Atlantic Bight. It is possible that these two spawnings represent different populations. A smaller fall and winter spawning which occurs offshore south of Cape Hatteras may represent a small population resident to the South Atlantic Bight.

Kennelly, S.J. 1999. Areas, Depths, and Times of High Discard Rates of Scup, *Stenotomus chrysops*, during Demersal Fish Trawling off the Northeastern United States. Fishery Bulletin. 97(1):185-192.

Abstract: In the waters off the northeastern United States, many stocks of commercial and recreational species have declined in recent years . Although much of the blame for these declines is ascribed to sustained overfishing, there also has been substantial concern over bycatch and discarding practices in key fisheries of the region, especially those involving demersal trawling. For many years scup (or porgy, Stenotomus chrysops) has been an important commercial species in the mid-Atlantic and southern New England regions, caught principally by otter trawling and to a lesser extent by pound nets, floating trap nets, and fish traps.

Kenney, R.D., G.P. Scott, T.J. Thompson, and H.E. Winn. 1997. Estimates of Prey Consumption and Trophic Impacts of Cetaceans in the USA Northeast Continental Shelf Ecosystem. Journal of Northwest Atlantic Fishery Science. 22:155-171.

Abstract: Whales, dolphins and porpoises are significant consumers of prey resources in the USA Northeast Shelf marine ecosystems to a far greater extent than was realized two decades ago. Seasonal estimates of the consumption of finfish, squid and zooplankton by cetaceans were calculated for 4 regions of the Northeast Shelf system defined as Gulf of Maine, Georges Bank, Southern New England and Mid-Atlantic Bight. Estimates were based on seasonal cetacean abundance using standard mammalian metabolic models scaled as appropriate for assimilation, activity and migratory fasting. Estimates were made of mean body mass and proportion of the diet comprised of each of the 3 main prey types. Cetaceans of the Northeast Shelf were found to consume nearly 1.9 million tons annually, including about 1.3 million tons of fish, 337 000 tons of squid and 244 000 tons of zooplankton. Their predation on fish and squid exceeded tonnages harvested in the commercial fishing industry. Consumption estimates of fish dominated in most regions and seasons, primarily because of the widespread distribution and high relative abundance of large piscivorous fin whales, and secondarily due to the presence of humpback and minke whales and some of the smaller odontocetes. Zooplankton consumption, principally by right and sei whales and secondarily by mysticetes, was significant in some seasons in the Gulf of Maine and Georges Bank regions. An assemblage who included a variety of teuthivorous odontocete species inhabiting the shelf break vicinity consumed substantial quantities of squid in all regions except the Gulf of Maine. Using a simple five-level trophic model and 10% estimated trophic transfer efficiency, the estimates implied that a significant fraction of the total net primary production, ranging from 11.7% in the Mid-Atlantic Bight to 20.4% in the Gulf of Maine, was required to support cetacean apex predation.

Kenney, R.D. and H.E. Winn. 1986. Cetacean High-Use Habitats of the Northeast United States Continental Shelf. Fishery Bulletin. 84(2):345-57.

Abstract: Results of the Cetacean and Turtle Assessment Program previously demonstrated at a qualitative

level that specific areas of the continental shelf waters of the northeastern U.S. coast consistently showed high-density utilization by several cetacean species. We have quantified, on a multispecies basis and with adjustment for level of survey effort, the intensity of habitat use by whales and dolphins, and defined areas of especially high-intensity utilization. The results demonstrate that the area off the northeast United States, which is used most intensively as cetacean habitat, is the western margin of the Gulf of Maine, from the Great South Channel to Stellwagen Bank and Jeffreys Ledge. Secondary high-use areas include the continental shelf edge and the region around the eastern end of Georges Bank. High-use areas for piscivorous cetaceans are concentrated mainly in the western Gulf of Maine and secondarily at mid-shelf east of the Chesapeake region, for planktivores in the western Gulf of Main and the southwestern and eastern portions of Georges Bank, and for teuthivores along the edge of the shelf. In general, habitat use by cetaceans is highest in spring and summer, and lowest in fall and winter.

King, J., J. Corbin, R. McMaster, J. Quinn, P. Gangemi, D. Cullen, J. Latimer, J. Peck, C. Gibson, J. Boucher, S. Pratt, L. LeBlanc, J. Ellis, and M. Pilson. 1995. A Study of the Sediments of Narragansett Bay : Volume I. The Surface Sediments of Narragansett Bay. Final Report Submitted to the Narragansett Bay Project. Graduate School of Oceanography. Narragansett, RI.

Abstract: The major objectives of this project described in this volume are to: (1) determine the contaminant concentrations in the surface sediments of Narragansett Bay and in freshwater impoundments behind dams in the Narragansett Bay system, (2) determine the characteristics of suspended sediments in the upper part of the Narragansett Bay system, (3) determine the relationship, if any, between sediment character and quahog meat quality, (4) compare the bay's sediment quality with sediment quality criteria, (5) use side-scan sonar to examine the texture and morphometry of the bottom of Narragansett Bay with an emphasis on the Providence River dredged channel.

Klein-MacPhee, G., B.K. Sullivan, and A.A. Keller. 1993. Using Mesocosms to Assess the Influence of Food Resources and Toxic Materials on Larval Fish Growth and Survival. American Fisheries Society Symposium. 14:105-116.

Abstract: At the Marine Ecosystems Research Laboratory (MERL), in Rhode Island, large-tank mesocosms have been designed to model Narragansett Bay. Results are presented from studies, using the MERL mesocosms, on the effects of nutrient enrichment and sediments on the growth and survival of larval winter flounder, and on the effects of exposure of tautog and cunner larvae to a starch blend being developed as a plastic substitute. The protocols for each experiment series are described. In the winter-flounder study, mesocosms without sediment had significantly higher survival rates than those with sediment, due to the competition for food from benthos. In the second experiment, no significant difference was found between larval survival in the mesocosm with added starch blend and the control, indicating that the compound was not toxic. However, larval growth was reduced in the starch-contaminated mesocosm, due to the preference of the larvae for the starch over copepods.

Knebel, H.J., S.W. Needell, and C.J. O'Hara. 1982. Modern Sedimentary Environments on the Rhode Island Inner Shelf, off the Eastern United States. Marine Geology. 49:241-256.

Abstract: Analyses of side-scan sonar records along with previously published bathymetric, textural and subbottom data reveal the sedimentary environments on the inner Continental Shelf south of Narragansett Bay, Rhode Island. The bottom topography in this area is characterized by a broad central depression bordered by shallow, irregular sea floor on the north and east and by a discontinuous, curvilinear ridge on the south and west.

Four distinct environments were identified:

(1) Pre-Mesozoic coastal rocks are exposed on the sea floor at isolated locations near the shore (water depths <32m). These exposures have pronounced, irregular topographic relief and produce blotchy patterns on side-scan sonographs.

(2) Glacial moraine deposits form the discontinuous offshore ridge. These deposits have hummocky sea-floor relief, are covered by lag gravel and boulders, and appear as predominantly black (strongly reflective) patterns on the side-scan records.

(3) Over most of the shallow, irregular bottom in the northeast, on the flanks of the morainal ridge, and atop bathymetric highs, the sea floor is characterized as a mosaic of light and dark patches and lineations. The dark (more reflective) zones are areas of coarse sands and megaripples (wavelengths = 0.81.2 m) that either have no detectable relief or are slightly depressed relative to surrounding (light) areas of finer-grained sands.

(4) Smooth beds that produce nearly featureless patterns on the sonographs occupy the broad central bathymetric depression as well as smaller depressions north and east of Block Island. Within the broad depression, sonographs having practically no shading indicate a central zone of modern sandy silt, whereas records having moderate tonality define a peripheral belt of silty sand.

The sedimentary environments that are outlined ranged from erosional or non-depositional (bedrock, glacial moraine) to depositional (featureless beds), and include areas that may reflect a combination of erosional and depositional processes (textural patchiness). The distribution and characteristics of the environments reveal the general post-glacial sedimentary history of this area and provide a guide to future utilization of the shelf surface.

Krabach, M.H. and J.H. Snooks. 1977. Coastal Zone Flushing Characteristics, NEP 1 & 2, Charlestown, Rhode Island. Yankee Atomic Electric Co. Westborough, MA.

Abstract: This report describes a portion of the environmental baseline monitoring program begun April 1974 by the New England Power Company to support their proposal to construct and operate a two-unit nuclear power plant at Charlestown, Rhode Island. This report details the field survey and analysis techniques to determine the near- and far-field flushing characteristics in Block Island Sound.

Kraus, S.D. and R.D. Kenney. 1991. Information on Right Whales (*Eubalaena glacialis*) in Three Proposed Critical Habitats in U.S. Waters of the Western North Atlantic Ocean. Report No. T-75133740. U.S. Marine Mammal Commission. Washington, DC. 72 pp.

Abstract: Three areas off the east coast of the United States have been proposed as critical habitat for right whales (Eubalaena glacialis) under the Endangered Species Act. The three areas include the coastal waters of the southeastern United States between mid-coast Georgia and Jupiter Inlet, Florida, the Great South Channel east of Cape Cod, Massachusetts, and the southern portion of Massachusetts Bay, including the eastern half of Cape Cod Bay. Right whale sighting information from the western North Atlantic collected between 1950 and 1989 was analyzed relative to the three areas. The data support the conclusion that the three proposed areas are essential to the population. The coastal waters of the southeastern United States are the primary calving ground for the population, and both Massachusetts Bay and the Great South Channel are significant feeding and nursery grounds for right whales. Human activities that occur in the areas and may require special management consideration include vessel traffic, dredging operations, fixed gear fishing activities, and offshore minerals exploration and development. [Contracts MMC-T-75133740, MMC-T-75133753. Prepared in cooperation with Rhode Island Univ., Narragansett. Graduate School of Oceanography. Sponsored by Marine Mammal Commission, Washington, DC.]

Kruczynski, W.L. 1974. Relationship Between Depth and Occurrence of Pea Crabs, *Pinnotheres maculatus,* in Blue Mussels , *Mytilus edulis,* in the Vicinity of Woods Hole, Massachusetts, USA. Chesapeake Sci. 15(3):167-169.

Abstract: Blue Mussels, *Mytilus edulis*, were collected from eight sites near Woods Hole, Massachusetts and examined for presence of the symbiont, *Pinnotheres maculates*. Mussels (550) from 6 intertidal areas

contained 2 crabs. Mussels (421) from 2 subtidal areas contained 238 crabs. Only 1% of mussels growing near the surface on a piling contained crabs, while those from depths of 10 feet and below were highly infected.

Kutty MK. 1968. Estimation of the Age of Exploitation at a Given Fishing Mortality. Journal Fisheries Research Board of Canada 25(6):1291-4.

Abstracts: According to the concept of eumetric fishing (Beverton and Holt, 1957) there is a particular age of exploitation or selection of gear which for a fish population will maximize the yield at a given fishing mortality rate (F). Apart from reading approximately the best age of exploitation for a given F from the eumetric fishing curve or from the equilibrium yield curve, no accounts are known to me giving a more precise method of estimating this important parameter. This note therefore gives a general algebraic solution of estimating the required age of exploitation.

Lamoureux, J.E. 1967. Analysis of the Zooplankton of Block Island Sound. USL Technical Memorandum No. 2213-180-67. U.S. Navy Underwater Sound Laboratory. New London, CT.

Abstract: The USNS SANDS (AGOR-6) conducted an oceanography/acoustic survey of Block Island Sound from 22 July to 10 August 1967. The information for this report was gathered as a part of the hydrologic survey section of this cruise from 22 July until 26 July 1967. The information was gathered by the use of Nansen casts, Ramsay probes, and the Bissett-Berman Hy-Tech unit. The hydrologic data used by the author in this report was determined from the Nansen casts alone, since the other data was not available at the time of this report. A general summation of the Block Island-Fishers Island Sound project, of which this cruise was a part, has been presented by Williams (8).

Langton, R.W., B.M. North, B.P. Hayden, and R.E. Bowman. 1980. Fish Food-Habit Studies - Sampling Procedures and Data Processing Methods Utilized by the Northeast Fisheries Center, Woods Hole Laboratory, USA. International Council for the Exploration of the Sea. Copenhagen, Denmark. 8 pp.

Abstract: Multispecies food-habit studies have been conducted by the Northeast Fisheries Center on both demersal and pelagic fish from 1963 to present. Fish stomachs have been, and are still, routinely collected as an adjunct to research vessel bottom trawl surveys carried out in the northwest Atlantic from Cape Hatteras, North Carolina, U.S.A., to Nova Scotia, Canada, an area of approximately 71,000 miles^2. Over the years fairly extensive data has been collected on 28 species constituting the major components of the finfish biomass and at least limited food-habits data exists on a total of 104 different species of fish. Part of this data base has been described in a series of recent publications (Edwards and Bowman, 1979; Langton and Bowman, 1980a and b; Grosslein, Langton, and Sissenwine, 1980; Bowman, 1980), which necessitated the development of automated data processing techniques for summarizing the data in various different ways.

Interest within I.C.E.S. concerning data on food fish and feeding habits was highlighted during the recent ad hoc working group meeting on multispecies assessment model testing (Demersal Fish Committee C.M. 1980/G:2). One of the recommendations of this group was the initiation of a fish stomach sampling scheme in the North Sea beginning in 1981. The participants of the meeting outlined past stomach sampling efforts and those currently in progress but relatively little time was devoted to the details of data processing and management. Since the Northeast Fisheries Center has been active in dealing with an increasingly large data base on fish stomach contents, and since our data processing system has evolved over 17 years we have prepared this document with the hope of assisting the proposed effort in the North Sea by helping to streamline an I.C.E.S. data management system based in part on our experiences.

Langton, R.W. and W.E. Robinson. 1990. Faunal Associations on Scallop Grounds in the Western Gulf of Maine, USA. Journal of Experimental Marine Biology and Ecology. 144(2-3):157-172.

Abstract: Benthic photographic transects were made during 1986-1987 across productive scallop beds on Jeffreys and Fippennies Ledges, western Gulf of Maine, from a manned submersible at depths of 56-84 m. Three megafaunal invertebrates dominated at each site: the sabellid worm Myxicola infundibulum (Renier) (mean densities ranging from 3.3 .+-. 4.2 to 7.1 .+-. 9.6 .cntdot. m-2); the burrowing cerianthid anemone Cerianthus borealis Verrill (1.0 .+-. 1.2 to 2.0 .+-. 0.5 .cntdot. m-2); and the sea scallop Placopecten magellanicus (Gmelin) (0.2 .+-. 0.5 to 1.0 .+-. 2.2 .cntdot. m-2). All three species exhibited contagious distributions (*i.e.*, occurred in large-scale clusters or patches), which could be modeled by negative binomial functions. On Fippennies Ledge, where little scallop dredging occurred in 1986, but, where appreciable fishing was conducted in 1987, sea scallops were positively associated with M. infundibulum and negatively associated with C. borealis in both years. In contrast, the association between M. infundibulum and C. borealis changed from a significant negative association in 1986 to random in 1987. The marked increase in scallop dredging on Fippennies Ledge between 1986 and 1987 was apparently the cause of a significant decline in the mean densities of all three megafaunal species (70% decline in sea scallops; 25-27% decline in cerianthids and myxicolids), although the pattern of faunal association with the sea scallops remained intact. On Jeffreys Ledge, where intensive dredging had occurred prior to our 1986 sampling, the pattern of faunal association described for Fippennies Ledge was absent. Thus, natural faunal associations may be severely impacted by fishing operations. We propose that C. borealis controls the spatial distribution and patch size of both M. infundibulum and P. magellanicus by preying on the larvae of the latter two species.

Lapolla, A.E. 2001. Bay Anchovy *Anchoa mitchilli* in Narragansett Bay, Rhode Island. I. Population Structure, Growth and Mortality. Marine Ecology Progress Series. 217:93-102.

Abstract: Population structure, growth, and mortality of *Anchoa mitchilli* were evaluated in Narragansett Bay (Rhode Island, USA), an estuary near the northern extent of this species' broad latitudinal range. The Narragansett Bay population was dominated by young fish (Age 1 and young-of-the-year, YOY); no fish were found to have survived a third winter. Growth rates were rapid, particularly during the first year of life, and annual mortality rates were estimated at >90%. A von Bertalanffy growth model fit to length-at-age data yielded parameters of asymptotic length L_∞ = 89.97, growth coefficient K= 1.15 and age at zero length t_o=0.31. Comparison of my results to those of an earlier study from Chesapeake Bay suggests that Narragansett Bay anchovies grow more rapidly during the first year of life, and subsequently attain a greater length-at-age, than their conspecifics at lower latitudes. Latitudinal differences are also indicated by comparison of the weight-length relationships and Fulton's condition factors of Narragansett Bay and Chesapeake Bay data. Narragansett Bay fish seem to be allocating energy preferentially to length versus weight compared to fish in Chesapeake Bay, which may be a reflection of this species' growth strategy at this latitude.

Lapolla, A.E. 2001. Bay Anchovy *Anchoa mitchilli* in Narragansett Bay, Rhode Island. II. Spawning Season, Hatch-date Distribution and Young-of-the-year Growth. Marine Ecology Progress Series. 217:103-109.

Abstract: Seasonality becomes more pronounced with increasing latitude, so that at northern sites organisms must adapt to a shorter growing season and more extended and severe over wintering conditions. Narragansett Bay (Rhode Island, USA) lies near the northern extent of the range of the bay anchovy *Anchoa mitchilli*, an abundant member of this estuarine system during the summer months. The length of the spawning season, hatch-date frequency, and young-of-the-year (YOY) growth rates were evaluated for Narragansett Bay anchovies during the summer of 1997 by gonadosomatic indices (GSI) and otolith-increment analysis. GSI data indicated a shorter spawning season for this species in Narragansett Bay than at lower latitudes. Otolith-increment analysis data indicated that hatch-date-frequency was highest in July. Mean YOY growth rate (0.70 mm d^{-1}) was much higher at this latitude than for conspecifics in Chesapeake Bay (0.47 mm d^{-1}). One possible adaptation to a shorter growing season is an increased growth rate during favorable conditions.

Latimer, J.S. 1988. A Review of Major Research Done in Rhode Island on PCBs in Water, Atmosphere, Sediment, and Biota from 1970 to 1986. URI.

Latimer, J.S., W.R. Davis, and D.J. Keith. 1999. Mobilization of PAHs and PCBs from in-place Contaminated Marine Sediments during Simulated Resuspension Events. Estuarine Coastal and Shelf Science. 49(4):577-595.

Abstract: A particle entrainment simulator was used to experimentally produce representative estuarine resuspension conditions to investigate the resulting transport of polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) to the overlying water column. Contaminants were evaluated in bulk sediments, size fractionated sediments, resuspended particulate material and in some cases, dissolved phases during the experiments. The two types of sediments used in the experiments, dredged material and bedded estuarine sediment, represented gradients in contaminant loadings and sediment textural characteristics. For the bedded sediment, resuspension tended to winnow the sediments of finer particles. However, in the case of the more highly contaminated dredge material, non-selective resuspension was most common. Resuspension resulted in up to orders of magnitude higher particle-bound organic contaminant concentrations in the overlying water column. Dissolved phase PAH changes during resuspension were variable and at most, increased by a factor of three. The sifting process resulted in the partitioning of fine and coarse particle contaminant loading. For bedded sediments, accurate predictions of PAH and PCB loadings on resuspended particles were made using the mass of resuspended particles of different sizes and the concentrations of contaminants in the particle pools of the bulk sediment. However, due possibly to contributions from other unmeasured particles (*e.g.* colloids), predictions were not possible for the dredge material. Thus, knowledge of the redistribution and fate of colloids may be important. The partitioning of PAHs between the dissolved and particulate phases during resuspension events was predicted to within a factor of two from the amount of organic carbon in each of the resuspended samples. These experiments show that contaminant transport is a function of the chemistry and textural characteristics of the bulk sediment and the winnowing action during resuspension events. Existing relationships of resuspension and settling velocity are probably useful in predicting chemical redistribution.

Lawson, R.M. 1984. Economics of Fisheries Development. Praeger. New York. 282 pp.

Abstract: The original impetus for this book came when, with the introduction of the 200-mile extended economic zone (EEZ), many developing countries suddenly found they had large fish resources, which–wisely managed and exploited–could generate wealth and income of immense benefit. However, one constraint to this was that many countries, for historic reasons, lacked the expertise to manage fisheries on this scale. Their needs seemed threefold: first, to establish the status of fisheries in both a national and international perspective; second, to provide enough theory of fishery economics to understand the implications of national policies; and third, to present problems and experiences of fisheries development in such a way that the application of theory would yield meaningful options and strategies for development.

A further impetus arose from the realization that few economists and especially development economists teaching in universities and colleges were able to incorporate Fisheries Economics into their courses owing to the lack of readily accessible material. Students were thus failing to recognize the global importance of fisheries as an economic resource capable of generating substantial wealth and income to many countries.

Lawton, R. 1974. A Literature Review of the Bluefish *Pomatomus saltatrix* (L), with Emphasis on Populations in Buzzards Bay, MA. M.S. Thesis. Southeastern Massachusetts University. North Dartmouth, MA. 24 pp.

Abstract: Data are analyzed to test the hypothesis that there are two races of bluefish, which enter Massachusetts waters in the early summer. This study also includes an age and growth analysis of three

year classes of bluefish collected from Buzzards Bay. This paper also reports on scale growth, sex ratio, and annulus formation. The data collected do not support the hypothesis of two races in Buzzards Bay, yet the scale method was verified as a valid aging technique for bluefish.

Lawton, R., E. Kouloheras, P. Brady, W. Sides, and M. Borgatti. 1983. Distribution and Abundance of Larval American Lobsters (*H. americanus*) in the Western Inshore Region of Cape Cod Bay. NOAA Tech. Rpt NFMS-SSRS-775:47-52. Pages 47-52. U.S. Department of Commerce.

Abstract: Larval lobster (*Homarus americanus*) abundance and distribution in the western inshore region of Cape Cod Bay, Mass., from 1974 to 1977 are reported. Lobster hatching generally began in mid-June, and the period of larval occurrence ranged from 46 to 62 d over the time and area studied. Maximum densities of larvae were collected in surface waters in July. Considerably more stage IV than stage I larvae were collected. Densities of lobster larvae were similar to levels obtained in several other New England investigations with the notable exception of Buzzards Bay where hatching was substantially greater.

Lazell, J.D., Jr. 1980. New England Waters: Critical Habitat for Marine Turtles. COPEIA. 2.

Abstract: New England waters, herein defined as all marine habitats north of the Nantucket Lightship, out to the "200 mile" limit, and north to Canadian territory, contain the largest known late summer and autumn (August-November) concentrations of the leatherback in the Atlantic. Inshore habitats in the southern sector (primarily Massachusetts) formerly supported thousands of Kemp's ridleys seasonally; despite overall decline of *Lepidochelys kempi*, they are still common in Massachusetts today. Loggerheads are common as far east as Georges Bank. A significant population of subadult greens summers in Nantucket Sound. The hawksbill is rare and probably accidental.

Leavitt, D.F., J.M. Capuzzo, and B.A. Lancaster. 1995. What does Condition Index tell Us about Softshell Clam Physiology? Journal of Shellfish Research. 14(1):243.

Abstract: Condition index is a frequency measured parameter used to assess and compare bivalve physiological status. For example, bivalve condition index measurements have been used in studies of contaminant effects, geographical variability of physiology, nutritional physiology, and aquaculture protocols. Usually calculated as a ratio of the soft tissue component to the shell component of a bivalve multiplied by some constant, it is used as an overall indicator of the physiological condition of the animal. But what exactly does a condition index data point tell us about the bivalve's physiology? To answer this question, we sampled field-collected softshell clams (Mya arenaria) on a monthly basis for 18 months from 2 sites within Buzzards Bay, MA. The sites were chosen to ensure significant variations in condition index of the clams between sites over the annual cycle. The clams were analyzed for a large suite of morphometric, biochemical, and reproductive parameters including: valve length, live weight, soft tissue wet and dry weights, lipid, protein, and glycogen content of viscera and digestive-gonad complex, sex, and gametogenic status. These data were then statistically analyzed and compared, using multivariate techniques, to assess those specific measurements of importance in defining the condition index of the bivalve and what method of calculating condition index gave us the most information on the clam's physiology. The results of statistical analyses will be presented in the context of evaluating a clam's physiological status relative to experimental or routine aquaculture conditions. (DBO)

Lee, T.C., S.B. Saila, and R.E. Wolke. 1991. Winter Flounder Contaminant and Pathological Survey: Narragansett Bay and Vicinity. Report No. NBP-91-51. Narragansett Bay Project. Providence, RI.

Abstract: The specific objectives of this study were to establish (within available time and field constraints) a valid baseline and sampling protocol for hepatic macrophage aggregate (HMA) parameters, hepatic lesions, and contaminants in winter flounder (*Pseudopleuronectes americanus*) in Narragansett Bay and adjacent areas.

This study was directed primarily toward obtaining a better understanding of the probable effects of pollution on stocks of winter flounder in Narragansett Bay and vicinity. Specifically, we sampled more than 400 winter flounder from three sites, which were presumed to represent a pollution gradient. These three sites were Warwick Neck, Whale Rock in Narragansett Bay, and Quonochontaug Pond, a coastal lagoon in southern Rhode Island.

Lee, V., et al. 2000. Narragansett Bay National Estuarine Research Reserve: Data Rescue Manual and CD-ROM. Coastal Resources Center, University of Rhode Island, Narragansett Bay Campus. Narragansett, RI.

Abstract: This CD Rom contains data collected from several agencies on the Narragansett Bay area. The CD Rom data consists mainly of GIS data layers. A manual is included on the CD Rom on how to use the data included.

Leonard, K. III, J. Dougal, M. Gomez-Chiarri, and A. Ganz. 1999. Detecting the Presence of *Perkinsus marinus* in the Eastern Oyster, *Crassostrea virginica*, in Rhode Island Waters. Journal of Shellfish Research. 18(1):331.

Abstract: Dermo and MSX, caused by the parasites Perkinsus marinus and Haplosporidium nelsoni respectively, have been responsible for oyster mortalities throughout the east coast of the United States. The goal of our research is to survey the prevalence and intensity of Dermo and MSX in Eastern oysters from Rhode Island waters. Oysters (30 per site) were collected from 8 locations in Rhode Island from May to November 1998, including 2 aquaculture sites. The prevalence and intensity of Dermo infection were evaluated using the Ray's Fluid Thioglycolate Medium (RTFM) method and by examining histological sections. MSX infections were evaluated using histological examination. We have detected the presence of Perkinsus marinus and Haplosporidium nelsoni in Rhode Island oysters. The intensity and prevalence of Dermo disease significantly varied between locations and sampling season. Highest Perkinsus marinus infection levels were seen in the August sampling session, and may be responsible for the oyster mortalities observed at several sites. The information obtained through this study will be useful to regulatory agencies in their management of the oyster populations in Rhode Island waters.

Letcher, B.H. and D.A. Bengtson. 1993. Effects of Food Density and Temperature on Feeding and Growth of Young Inland Silversides (*Menidia beryllina*). Journal of Fish Biology. 43(5):671-686.

Abstract: Food consumption and growth rates of 7-28-day-old *Menidia beryllina* were measured in response to natural ranges of temperature and prey availability. Feeding level, temperature and age all had significant effects on growth rate, although the effect of feeding level explained most of the variance. Feeding level also had a significant effect ton gross growth efficiency, but temperature and age did not. Absolute growth rates (mg per day) increased dramatically with temperature, feeding level, and age. Variability in growth was greatest for fish feeding at the lowest feeding level. For a given fish weight, temperature had a positive effect on consumption rate, and maximum consumption (C) of any treatment combination reached 75% body weight per day. Maximum growth rate was estimated at 24 6% body weight per day, and grow growth efficiency reached an estimated maximum of 0 375 at an ingestion rate of 25% body weight per day. Starved larvae lost on average 5 4% body weight per day and larvae required 6 4% body weight food consumption per day for maintenance. Multiple regressions of feeding level, temperature, and age/size on instantaneous growth rates indicated that increases in temperature increased maintenance requirements and required that fish consume a greater proportion of C to attain maximum growth. Growth rates decreased with increases in temperature for fish eating a specific weight of food.

Levin, L.A., R.J. Etter, and M.A. Rex. 2001. Environmental Influences on Regional Deep-sea Species Diversity. Annual Review of Ecology and Systematics. 32:51-93.

Abstract: Most of our knowledge of biodiversity and its causes in the deep-sea benthos derives from regional-scale sampling studies of the macrofauna. Improved sampling methods and the expansion of

investigations into a wide variety of habitats have revolutionized our understanding of the deep sea. Local species diversity shows clear geographic variation on spatial scales of 100-1000 km. Recent sampling programs have revealed unexpected complexity in community structure at the landscape level that is associated with large-scale oceanographic processes and their environmental consequences. We review the relationships between variation in local species diversity and the regional-scale phenomena of boundary constraints, gradients of productivity, sediment heterogeneity, oxygen availability, hydrodynamic regimes, and catastrophic physical disturbance. We present a conceptual model of how these interdependent environmental factors shape regional-scale variation in local diversity. Local communities in the deep sea may be composed of species that exist as metapopulations whose regional distribution depends on a balance among global-scale, landscape-scale, and small-scale dynamics. Environmental gradients may form geographic patterns of diversity by influencing local processes such as predation, resource partitioning, competitive exclusion, and facilitation that determine species coexistence. The measurement of deep-sea species diversity remains a vital issue in comparing geographic patterns and evaluating their potential causes. Recent assessments of diversity using species accumulation curves with randomly pooled samples confirm the often-disputed claim that the deep sea supports higher diversity than the continental shelf. However, more intensive quantitative sampling is required to fully characterize the diversity of deep-sea sediments, the most extensive habitat on Earth. Once considered to be constant, spatially uniform, and isolated, deep-sea sediments are now recognized as a dynamic, richly textured environment that is inextricably linked to the global biosphere. Regional studies of the last two decades provide the empirical background necessary to formulate and test specific hypotheses of causality by controlled sampling designs and experimental approaches. Reprinted by permission of the publisher.

Li, Y. and T.J. Smayda. 1998. Temporal Variability of Chlorophyll in Narragansett Bay, 1973-1990. ICES Journal of Marine Science. 55:661-667.

Abstract: Weekly measurements of Chl *a* were carried out between 1973 and 1990 in Narragansett Bay, Rhode Island, a temperate estuary along the northeaster US coast. There was only a threefold variation in mean annual chlorophyll values but a considerably greater variation in the period when the annual maximum was reached. The inter-annual variation in annual means was relatively modest compared with monthly means. For a given month, the inter-annual variability in monthly mean chlorophyll varied from 3- to 30-fold; it was least during the summer months and maximal during the winter-spring bloom period. The long-term variability patterns characterizing individual months differed in their trends, cycles, and irregular fluctuations. Major blooms occurred during most of the year, and were not restricted to the annual winter-spring bloom. However, the frequency and magnitude of blooms were higher during winter-spring months than during summer months. A significant finding is that the annual mean chlorophyll decreased by more than 1 mg m year over the 18-year time series. This decrease apparently was under multifactorial control, with zooplankton grazing, sea surface temperature and windspeed being the most important factors.

Lidz, L. 1963. Sedimentary, Environmental and Foraminiferal Parameters, Nantucket Bay, Massachusetts. Master's Thesis. University of Southern California. Los Angeles, CA.

Limeburner, R., R.C. Beardsley, and W. Esaias. 1980. Biological and Hydrographic Station Data Obtained in the Vicinity of Nantucket Shoals, May 1978 - May 1979. Report WHOI-80-7; Report to NOAA Sea Grant Program. Woods Hole Oceanographic Institution. Woods Hole, MA. 87.

Lloyd, D.E., Jr. 1988. Application of Hepatic Macrophage Aggregates as Health Monitors of Narragansett Bay Winter Flounder, *Pseudopleuronectes americanus*. URI.

Abstract: The relative health of Narragansett Bay winter flounder (Pseudopleuronectes americanus) was assessed by means of hepatic macrophage aggregates (MAs) and liver lesions as a function of site, season, and sex. Numbers and sizes of MAs as well as numbers of vacuolated hepatocytes were significantly elevated in winter flounder from Warwick Neck, the site of the severest contamination as evidenced by increased tissue burdens of selected pollutants. Significantly lower MA values were observed in winter

flounder livers from Whale Rock and Quonochontaug Pond winter flounder.

A significant difference between male and female MA parameters was observed only in Warwick Neck where male values were significantly higher than female values. No seasonal effect was observed. MA parameters and tissue pollutant burdens of PCBs and selected heavy metals revealed significant correlations.

Long, E.R. and L.G. Morgan. 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service. Seattle, WA.

Abstract: National Oceanic and Atmospheric Administration (NOAA) annually collects and chemically analyzes sediment samples from sites located in coastal marine and estuarine environments throughout the United States as a part of the National Status and Trends (NS&T) Program. While the chemical data provide indications of the relative degrees of contamination among the sampling sites, they provide neither a measure of adverse biological effects nor an estimate of the potential for effects. Data derived from a wide variety of methods and approaches were assembled and evaluated to identify informal guidelines for use in evaluation of the NS&T Program sediment data. The data from three basic approaches to the establishment of effects-based criteria were evaluated: the equilibrium-partitioning approach, the spiked-sediment bioassay approach, and various methods of evaluating synoptically collected biological and chemical data in field surveys. The chemical concentrations observed or predicted by the different methods to be associated with biological effects were sorted, and the lower 10 percentile and median concentrations were identified along with an overall apparent effects threshold. The lower 10 percentile in the data was identified as an Effects Range-Low (ER-L) and the median was identified as an Effects Range-Median (ER-M). Note that these ER-L and ER-M values are not to be construed as NOAA standards or criteria. The ambient NS&T Program sediment data from sampling sites were compared with the respective ER-L and ER-M values for each analyte. The comparisons were used to rank sites with regard to the potential for adverse biological effects, assuming that the sites in which the average chemical concentrations exceeded the most ER-L and ER-M values would have the highest potential for effects. The ranking indicated that a sampling site located in the Hudson-Raritan estuary had the highest potential for effects, followed by a site located in Boston Harbor, a site located in western Long Island Sound, and a site located in the Oakland estuary of San Francisco Bay.

Lund, W.A., Jr. and G.S. Maltezos. 1970. Movements and Migrations of Tagged Bluefish off New York and Southern New England. Transactions of the American Fisheries Society. 99(4):719-725.

Abstract: Bluefish were tagged in and near Long Island Sound between 1964 and 1969. Tag returns support the belief that there is a discrete northern race of bluefish, as more than 75% of the returns from fish at large more than one season return to the general area of Long Island Sound. Small bluefish move southward along the coast during late fall while adults, fish over approximately 45 cm total length, have an inshore-offshore migration.

Bluefish first arrive in the area when the water temperatures reach 12 to 15 C, which is usually during May. The fish follow the warmer water by entering the inner bays of Long Island or going to the western end of Long Island Sound. Large numbers of bluefish arrive in the general area during late July and August after spawning in offshore waters. The fall migration takes place when the water temperature drops to approximately 13 to 15 C.

Lund, W.A., Jr. and L.L. Stewart. 1970. Abundance and Distribution of Larval Lobsters, *Homarus americanus*, off the Coast of Southern New England. Proceedings of the National Shellfisheries Association. 60:40-49.

Abstract: Lobster larvae were collected over a four-year period off southern New England. They were widely distributed in offshore waters and only three tows contained significant numbers of larvae. Inshore lobster larvae were most abundant during the latter part of June and July. They were found to be more concentrated in the western end of Long Island Sound and it is proposed that the direction of currents is responsible for this higher abundance. Survival rates from stage I to stage IV were estimated to be over 50% with very little mortality between stage II and stage III larvae.

Lux, F.E. and F.E. Nichy. 1971. Numbers and Lengths, by Season, of Fishes Caught with an Otter Trawl Near Woods Hole, Massachusetts, September 1961 to December 1962. U.S. Fish and Wildlife Service Special Science Report. 622:1-15.

Abstract: Forty-one species of fish were caught in hauls made about four times per month at water depths of 2 to 15 feet (0.6 to 4.6 m.) in Woods Hole harbor. Seasonal occurrence is discussed and compared with water temperature. Data on growth during the first year are given for a number of species.

Lynch, T. R. 2000. Assessment of recreationally important finfish stocks in Rhode Island waters. Coastal Fishery Resource Assessment Trawl Survey. Segment 8. Project Number F-61-R

Abstract: Fifty twenty-minute bottom trawls were successfully completed during the Narragansett Bay seasonal segment, while 107 were completed during the Narragansett Bay monthly segment. Data on weight, length and numbers were gathered on 47 species during the Narragansett Bay seasonal assessment and 58 species during the Narragansett Bay monthly assessment.

Lynch, T.R. 1994. Tautog Studies - Narragansett Bay and Rhode Island Coastal Waters 1987 - 1993 Completion Report. Volume Project Rpt. No. F-54-R-5. Rhode Island Division of Fish and Wildlife.

Abstract: The tautog (Tautoga onitis) is one of several species comprising the wrasse or Labrid family (Nelson '84, in ASMFC '95). They are distinguished from the only other member of this family found in these waters (cunner, Tautogolabrus adspersus) by their high head profile, large lips and stouter body form (Bigelow & Shroeder '53).

The movement and localized nature of tautog within Narragansett Bay and adjacent coastal waters have been documented through the efforts of Chenoweth ('63) and Cooper ('64). Their conclusions as to time of arrival, peak concentration and departure, have been confirmed and expanded through this program. Corroborative evidence continues to be provided by fishery independent assessments conducted by state, academic, and utility agencies, as well as recreational and commercial harvest data.

MacConnell, W.P. 1975. Remote Sensing 20 years of Change in Massachusetts, 1951/52-1971/72. Bulletin No. 630. Mass. Agric. Exper. Station, College of Food and Nat. Res., U. Mass. Amherst.

Abstract: This study examines the state of Massachusetts as it was mapped by the author from aerial photographs taken in 1951 and 1952. It also determines in detail the land use, vegetation cover types and the nature of the land and water itself on aerial photographs taken in 1971 and 1972. It compares and contrasts the situation after a 20-year time span and will attempt to predict what is likely to occur in the next 20 years. By the use of time-lapse aerial photo analysis the study exposes those areas most pregnant for development and makes possible prediction of what that development is most likely to be.

MacIlvaine, J. 1973. Sedimentary Processes on the Continental Slope off New England. MIT/WHOI Joint Program, Woods Hole Ocean. Inst. Woods Hole, MA.

Abstract: A detailed study of a small (5000 km²) area of the continental slope south of Cape Cod, Massachusetts, was conducted. Bathymetry, 3.5 kHz profiles, seismic profiles, suspended sediment analysis, bottom photographs, television, laboratory flume experiments, studies of surface sediments, and piston cores were combined to form the basis for understanding the sedimentary processes which control transportation, deposition, and erosion of sediments, and the geomorphic features of the continental slope.

Gravitational processes (slumping, creep, and turbidity currents) are apparently the most effective erosional processes on the continental slope. Massive large-scale failure occurs where the slope steepens from a gradient of 1.5° to 7.6°, producing scarps hundreds of meters in height. Upslope propagation of slumping on the upper continental slope has formed steep-sided gullies with layers of disturbed residual material and hummocky floors. On the steep lower continental slope small slump scars on the order of 100 m in horizontal extent and several meters high are common. Material removed by slumping is emplaced at the foot of the continental slope as intact and disrupted blocks 1 to 100 m thick. Turbidity currents generated by slumping have apparently eroded V-shaped gullies in the lower continental slope.

Bottom currents are most influential at the shelf-break, where they produce sorting of surface sediments and suspension of fine material by erosion of the bottom. Internal waves may be a significant source of high velocity bottom currents and turbulence. Laboratory flume experiments and observation of the bottom indicate that the sediments of most of the continental slope are not normally affected by bottom currents. Sediments at the foot of the continental slope on the upper continental rise are reworked by bottom currents.

Biological activity causes both roughening and smoothing of the sediment surface. Tracking of the bottom produces small-scale roughness, and reworking of the bottom reduces larger roughness elements. Biological production of fibrous structures helps render the sediment surface extremely resistant to erosion by bottom currents. Biological erosion of rock outcrops produces rubble slopes locally at the bases of scarps.

Conditions have varied markedly during the Pleistocene and Holocene. During glacial periods rapid deposition increased the activity of gravitational processes, while during interglacial period of slow deposition biological and hydrodynamic processes became relatively more important.

Mackay, J. 1997. Benthic Invertebrates at a Nearshore Disposal Site in Narragansett Bay (Providence River) and Post-disposal Recovery. Prepared by J. Mackay, New England Division, U.S. Army Corps of Engineers. Unpublished Manuscript.

MacKenzie, C. and J.R. Moring. 1985. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) - American Lobster. U.S. Army Corps of Engineers, TR EL-82-4. U.S. Fish and Wildlife Service, Biological Report 82(11.33). 19 pp.

Abstract: Species profiles are literature summaries of the taxonomy, morphology, distribution, life history, and environmental requirements of coastal aquatic species. They are designed to assist in environmental impact assessment. The American lobster (Homarus americanus) is a valuable commercial shellfish. After spawning, lobsters undergo a series of molts; as adults they live in coastal and offshore waters. Lobsters are captured in baited traps and incidentally in trawls. About 5-6 million pounds were captured commercially in 1983, a downward trend from 1971. Major environmental factors affecting reproduction, growth, and survival are water temperature, oxygen concentration, salinity, and substrate.

MacLean, S.A. 1993. Pathological Conditions of Narragansett Bay Young-of-the-year Winter Flounder. American Fisheries Society Symposium. 14:47-54.

Abstract: A total of 107 young-of-the-year winter flounder (Pleuronectes americanus) was collected in June and August from three sites representing a pollution gradient in Narragansett Bay. Three- to 5-month-old fish were afflicted with a variety of parasites and pathologic conditions. A few conditions, including gastritis, inflammatory heart conditions, and the only occurrence of gill bifurcation, appeared only at Gaspee Point, the most contaminated site sampled in the bay. The microsporidan Glugea was found in only one fish from the least contaminated site. Some conditions appeared more frequently in the older fish than in the younger ones; trematode metacercaria (Cryptocotyle) infections increased at two stations from 20% in June to 100% in August, while infection intensities increased from 1 to 2 cysts of metacercaria per fish in June to 188 cysts per fish in August (it is notable that metacercariae were not found on fish from the most polluted site); epitheliocystis-like lesions in gills increased from 2% in June to 59% in August; gill hyperplasia and fusion increased from 24% in June to 41% in August. This study reports on melanized fibrosis in the liver and parasites (coccidians and myxosporidans) not previously recorded in winter flounder. These conditions are discussed relative to year-class success.

Macy, W.K., III and J.K.T. Brodziak. 2001. Seasonal Maturity and Size at Age of *Loligo pealeii* in Waters of Southern New England. ICES Journal of Marine Science. 58(4):852-864.

Abstract: This paper investigates patterns of size-at-age and of maturity-at-size and -age using data from opportunistic, seasonal collections of Loligo pealeii from fisheries and research surveys off southern New England during 1993-1997. We describe basic life history parameters, such as lifespan, size and age at 50% maturity, size at stage of sexual maturation, and growth rates by sex and hatch month. The results provide new quantitative information on the population structure of L. pealeii and provide evidence that the link between the inshore and offshore components of the stock may be more complicated than formerly believed. Age composition appeared to be stable throughout the year, except during autumn, with modal ages at capture of only 150-180 d. L. pealeii spawning was inferred to occur throughout the year based on observed ages. Direct age sampling of the inshore and offshore fisheries for L. pealeii showed that these seasonal fisheries likely interact and that each harvests squid spawned in the previous season.

Malinowski, S.M., M.A. Rice, and D. Grossman-Garber. (Eds.). 1993. Effects of Density on Adult Growth, Survivorship, Fecundity, and Recruitment of Northern Quahogs. Pages 79-90 pp In: Proceedings of the Second Rhode Island Shellfish Industry Conference. Narragansett, Rhode Island, August 4, 1992. Rhode Island Sea Grant. Narragansett, Rhode Island.

Abstract: A population study of quahogs (Mercenaria mercenaria) near Fishers Island, eastern Long Island Sound, was conducted from June 1982 to 1983. Quahogs were sampled using a diver-quadrat methodology. Additional manipulative field experiments were performed in which quahogs were placed at varying densities in subtidal plots with -inch mesh predator exclusion screens. The average density of quahogs was 12.3/m super(2). Age determinations suggest that in the past fifteen years, there had been only two significant years of quahog Average annual recruitment was approximately 0.21 quahogs/m super(2)/yr. Growth of quahogs at the study site is extremely slow, survival of quahogs > 35 mm valve length was very high (0.915-0.955). Survival of these quahogs (> 35 mm) is independent of density. suggests that quahogs are extremely long lived and recruitment rates are very low. Thus, sustainable harvest from this Fishers Island population is only 0.5 quahogs/m super(2)/yr.

Mann, R. 1990. Larval Ecology of *Arctica islandica* on the Inner Continental Shelf of the Eastern United States. Journal of Shellfish Research. 8(2):464.

Abstract: *Arctica islandica* occupies a wide latitudinal and bathymetric range on the inner continental shelf of the eastern United States. The inshore limit of distribution limit appears to be limited by the 16C bottom isotherm in the summer months. Adults exhibit some burrowing activity but laboratory observations suggest they are rather sedentary. This behavior suggests that larval settlement occurs

throughout the adult distribution range (*i.e.* immigration of post settlement stages is relatively unimportant). But where do the larvae come from? *Arctica islandica* larvae are long lived and the Middle Atlantic Bight, at least, exhibits a residual bottom flow. This presentation reviews current knowledge of seasonal net flow on the eastern continental shelf and incorporates data on larval development rate to speculate on possible distances of *Arctica islandica* larval dispersion on the inner continental shelf.

Margraf, F.J. and L.M. Riley. 1993. Evaluation of Scale Shape for Identifying Spawning Stocks of Coastal Atlantic Striped Bass (*Morone saxatilis*). Fisheries Research (Amsterdam). 18(3-4):163-172.

Abstract: We review a numerical method of associating fish of unknown stock affiliation with their respective spawning stocks on the basis of differences in quantified scale shape. Magnified images of fish scales are digitized and the shapes of the scales are transformed into a mathematical relationship (Fourier series), from which the original shape can be regenerated with little loss of resolution. A multiple, stepwise discriminant analysis is used to characterize each putative stock within a fishery on the basis of the shape of the scales from fish in the population. Also, classification criteria are developed by which individual fish can be assigned to their respective stocks on the basis of scale shape. The shape of scales of Atlantic striped bass, Morone saxatilis, was characterized to evaluate the use of the method for this fishery. Differences in scale shape between Hudson River and Chesapeake Bay fish were sufficient to allow classification of individuals to their area of origin with 80% accuracy. To demonstrate the use of the procedure, we estimated, from 89 striped bass scales taken in the Rhode Island November 1982 fishery, that 45% were from the Hudson River and 55% from Chesapeake Bay. Similarly, from 100 scales taken from fish in the eastern Long Island April-December 1982 fishery, 53% were of Hudson River origin and 47% were from Chesapeake Bay.

Marine Research, Inc. 1997. Aquatic Ecology Studies in the Providence and Seekonk Rivers in the Vicinity of the Manchester Street Repowering Project, February - November 1996. Submitted to Narragansett Electric Company and New England Power Company, Westborough, MA, April 10, 1997. 97 pp.

Marine Research, Inc. 1996. Semi-annual Biological and Hydrological Report - 1996, New England Power Company, Brayton Point Station NPDES Discharge Permit Number MA0003654. Submitted to New England Power Company, Westborough, MA. 29 pp.

Martin, M.H. 1995. The Effects of Temperature, River Flow, and Tidal Cycles on the Onset of Glass Eel and Elver Migration into Fresh Water in the American Eel. Journal of Fish Biology. 46(5):891-902.

Abstract: Anguilla rostrata elvers were collected in the Annaquatucket R., Rhode Island, and their otoliths extracted. Daily increments beyond the check mark formed upon entry into fresh water were counted and the date of freshwater entry was estimated. The effects of river temperature, difference between seawater and freshwater temperature, river flow and tidal stage on the number of elvers arriving on each date were estimated for six collection dates. At the earliest collection date (23 March), increasing river temperatures and reduced flow increased elver migration. At later dates (16 May-12 June), tidal stage was the most important factor in determining the magnitude of elver migration.

Massachusetts Department of Environmental Management. 2002. DEM Forests and Parks: Commonwealth of Massachusetts

Abstract: This is a listing from the Commonwealth of Massachusetts Department of Environmental Management website of all state parks and forests in Massachusetts.

Massachusetts Department of Environmental Protection. 2002. Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the United States within the Commonwealth. Http://www.state.ma.us/dep/brp/wm/wqstds.htm.

Abstract: 314 CMR 9.00 sets forth the certification standards for proposed discharge of dredged or fill material, dredging, and dredged material disposal into Massachusetts coastal and inland water bodies. These Regulations are administered by the Department's Bureau of Resource Protection. BWP's Water Program regulates disposal or reuse options of dredged material at landfills only. These Regulations were effective as of 8/25/95.

Massachusetts Division of Marine Fisheries. 1976. Commercial Fisheries Research and Development Act: Evaluation of Winter Flounder: Year-class Success.

Mather, F.J. III. 1957. Distributional Records of Fishes from Waters off New England and the Middle Atlantic States. Copeia. 1957(3):242-244.

Abstract: The data recorded here concern either species, which are new to or have seldom been recorded from certain areas, or distributional information, which has bearing upon the life histories of species. In addition to our personal observations, sources of records, for which we are greatly appreciative, include Captain Norman Benson, Mr. L.R. Day, of the Fisheries Research Board of Canada, and members of the crews and scientific parties of the research vessels ATLANTIS, BEAR, BLUE DOLPHIN, and CARYN of the Woods Hole Oceanographic Institution.

Mather, F.J. III . 1954. Northerly Occurrences of Warm Water Fishes in the Western Atlantic. Copeia. 1954 (4):292-293.

Abstract: In the summer and fall of 1953, I was able to record several northerly occurrences of warm-water fishes of the families Scombridae, Carangidae and Coryphaenidae. These include some individuals taken from research vessels of the Woods Hole Oceanographic Institution in offshore waters, and others caught in Mr. Norman Benson's trap at Quissett, Massachusetts, in Buzzards Bay.

Some of the captures appear to constitute new northern records. Others are of species which have previously been listed from these latitudes but whose occurrences there are not often described in the literature. Abundance or scarcity of the respective species was checked in Bigelow and Schroeder (1953, Fish. Bull. U.S.F.W.S., 53 (74): 1-577) for the Gulf of Maine, and in Nichols and Breder (1934, Zoologica, 9 (1): 1-192) for New York and southern New England, and other regional works, as well as COPEIA and the *Zoological Record*.

Matthiessen, G.C. and M.D. Scherer. 1983. Observations on the Seasonal Occurrence, Abundance, and Distribution of Larval Lobsters (*H. americanus*) in Cape Cod Bay. NOAA Tech. Report NMFS-SSRF-775. Pages 41-46. U.S. Department of Commerce.

Abstract: The seasonal occurrence, abundance, and distribution of the larvae of the American lobster, *Homarus americanus*, in Cape Cod Bay were studied over a 3-yr period (1974-76). Although larvae were observed during the months of May-September, the great majority were found to occur during June, July, and August. In the neuston net collections, mean larval densities for these 3 mo averaged 3.1, 3.2, and 1.6 larvae/1,000 m^3, respectively. However, densities as high as 62.3 larvae/1,000 m^3 were observed in Tucker net collections near the east end of Cape Cod Canal.

The seasonal occurrence, pattern of distribution, and relative abundance of first-stage larvae near the east end of Cape Cod Canal during June suggest the likelihood that the Canal may contribute significant numbers of larvae to Cape Cod Bay.

McBride, R.S., M.D. Scherer, and J.C. Powell. 1995. Correlated Variations in Abundance, Size, Growth, and Loss Rates of Age-0 Bluefish in a Southern New England Estuary. Transactions of the American Fisheries Society. 124(6):898-910.

Abstract: Age-0 bluefish Pomatomus saltatrix were widely distributed and seasonally abundant in shallow beach habitats of Narragansett Bay, Rhode Island. Based on length-frequency data that were polymodal in some years, these age-0 fish comprised spring- and summer-spawned cohorts. Cohort-specific measures of abundance, growth, total mortality and emigration, and size were determined for 1982-1992. In all years, spring-spawned fish dominated the catch from at least July to September. For this cohort, annual abundance varied by an order of magnitude, growth ranged from 0.9 to 2.1 mm/d, total mortality and emigration rates were between 0.2 and 2.8%/d, and mean length on October 1 ranged from 164 to 248 mm fork length. Spring-spawned fish were about twice as large as summer-spawned fish by October. Summer-spawned fish also occurred less frequently and in lower abundance. These findings confirm that Narragansett Bay is an important nursery for bluefish, and that the trend toward declining annual abundance measured in this bay is concordant with the reported decline of bluefish throughout the western Atlantic. Correlation analysis with data for only the spring-spawned cohort suggested density-dependent (*i.e.*, compensatory) processes occurred; growth decreased monotonically but not linearly, relative to abundance, whereas combined mortality and emigration rates increased linearly. Measures of abundance were also a function of seine-net size; seines less than 25 m long were particularly ineffective for collecting age-0 bluefish. These relationships suggest that monitoring age-0 fish in estuaries may help predict future population size.

McElroy, A.E., J.W. Farrington, and J.M. Teal. 1990. Influence of Mode of Exposure and the Presence of a Tubiculous Polychaete on the Fate of Benz(a)anthracene (BaA) in the Benthos. Environmental Science and Technology. 24(11):1648-1655.

Abstract: Influence of mode of exposure and the presence of a tubiculous polychaete on the fate of benz(a)anthracene (BaA) in the benthos. The distribution and metabolism of radio labeled BaA were followed in 2 L benthic microcosms containing 1.4 L of sea water and 450 g of sediments from Buzzards Bay, MA, in the presence and absence of the polychaete worm Nereis virens for 5-25 days to assess the effects of the mode of introduction and the presence of large burrowing organisms on the fate of PAH and their metabolites in the benthos. Both factors had significant and interactive effects on the fate of BaA in this system. BaA added to the water column was more available for uptake and metabolism by worms and for microbial mineralization to CO(sub)2 than BaA previously sorbed on the sediments. The ability of infaunal organisms to accumulate and metabolize PAH, and their ability to stimulate microbial degradation and flux of these compounds from these sediment reservoirs, represents processes that are important in the ultimate fate and potential toxicity of many lipophilic contaminants. Tables, graphs, and 41 references.

McGetchin, T.R. 1961. Bottom Sediments and Fauna of Western Narragansett Bay, Rhode Island. Brown University.

Abstract: Forty-seven sediment and biological samples were examined from the western half of Narragansett Bay, a slightly hyposaline, positive tidal estuary, entering the Atlantic Ocean toward the south. The physical character and distribution of sediments, and the composition and distribution of fauna is described.

Five sedimentary environments can be differentiated by composition, texture, and sorbing of sediments. Two are high energy environments, located generally in the south where tidal current velocities in the channels and wave action along the shore are greatest; three, of lower energy, occur northward.

Six animal groups are identified: the epifaunal Mytilus and Crepidula-Anomia groups; the sandy or mixed bottom infaunal groups, Astarte-Veneri-cardia and Tellina-Spisula; and the soft bottom infaunal groups, Mulinia-Nephthys and Nucula-Nephthys.

The presence and abundance of organisms is largely determined by the nature of the substrate, while the sediment types are controlled by the strength of tidal currents and wave action. These factors, in turn, are

governed by the special configuration of the channels and shoreline. Thus, it seems that the distribution and abundance of fauna in western Narragansett Bay is fundamentally controlled by the geometry of the Bay.

McKnight, A., L. Mathews, R. Avery, and K.T. Lee. 1997. Distribution and Color Morph Ecology of Green Crabs in Southern New England. Journal of Shellfish Research. 16(1):356.

Abstract: The invasive marine crab Carcinus maenas colonized eastern North America in the mid-nineteenth century. Since its introduction, C. maenas has become a prominent species in southern New England, and poses a threat to commercial mollusk fisheries along the New England coast. In Europe C. maenas exhibits a range of coloration from pale green through red. Physiological and distributional differences between green and red morphs have been documented. This study attempted to discover whether western Atlantic populations of C. maenas exhibited a similar color morph ecology. Crabs were collected from sites in New England. Distribution of crabs was evaluated in subtidal, intertidal and estuarine sites, and morphological characteristics were recorded for all captured crabs. Green morphs outnumbered red morphs in all habitat types; however, red morphs were more abundant in subtidal sites than in any other habitat type. In estuarine sites, red morphs became less abundant with increasing distance from the estuary mouth. Red morphs were larger on average than green morphs. In subtidal crabs, red morphs exhibited more carapace fouling than green morphs, and red males were found to suffer a greater incidence of limb loss than green males. These results generally followed trends reported in European populations.

McMaster, R.L. 1960. Sediments of Narragansett Bay System and Rhode Island Sound, Rhode Island. Journal of Sedimentary Petrology. 30(2):249-274.

Abstract: Gravel, sand, silt, and clay content was determined for 942 samples from the bays and adjacent inner shelf to a distance of some 20 miles off the Rhode Island coast.

In the Narragansett Bay system clayey silt and sand-silt-clay are the most abundant sediments although sand is important locally. Neither the Bay system nor the inner shelf contain a predominant clay type of sediment. Primarily, sediments are derived from the unconsolidated subaerial and subaqueous glacial and post-glacial deposits. It is believed that the sediment available for deposition is composed of some fine and very fine sand, silt, and clay, but the quantity is very small. During the period in which present environmental conditions have been effective clayey silt and sand-silt-clay have accumulated for the most part in the more protected middle and upper areas of the Bay system. The depositional sites for the finest of these sediments may be the result of the peculiarities of surface tidal current flow. Areas, which show marked gradational changes in texture probably, indicate significant local variations in current activity along the bottom interface. In general, toward the lower reaches of the Bay passages the sediments show a progressive change to coarser textures.

On the inner shelf the predominant sediment type is clean, well-sorted sand. Apparently gravel is concentrated along two major trends, which are generally associated with the two submarine elevation features that cross the area. A well-defined depositional zone of sandy silt and silty sand, believed to be the result of non-tidal drift, begins near the entrances to Narragansett Bay and follows the trend of a winding submarine slope toward the southwest and Block Island Sound. A tongue of sand, which lies adjacent to the Rhode Island mainland from Point Judith into lower West Passage, owes its origin to the northerly moving longshore current, which pushes into the Bay from Block Island Sound.

In the Bay system and certain areas on the inner shelf unburied glacial or post-glacial lag deposits juxtapose with recently accumulated fine sediments.

Present environmental forces are not responsible for the creation of the major submarine topographic features of the region, but in the Bay depositional processes of recent environmental conditions have had considerable success in burying sedimentary deposits of previous environments.

McMaster, R.L. and A. Ashraf. 1973. Extent and Formation of Deeply Buried Channels on the Continental Shelf off Southern New England. Journal of Geology. 81:374-379.

Abstract: Seismic reflection profiles reveal a network of deeply buried channels that extends from coastline buried bedrock valleys to some 50 km off Rhode Island. Thalwegs below sea level reach 100–286 m in Coastal Plain deposits. The limited extent, depth, and longitudinal profiles of these channels together with the seaward lobate boundary of the channel pattern suggest severe ice scour modifications of late Tertiary–early Pleistocene preglacial river valleys. Maximum ice advance is correlated with a pre-Woodfordian ice margin of the Wisconsin stage.

McMaster, R.L. and W.B. Clarke. 1956. A Survey of Bottom Surface Sediments in Upper Narragansett and Mt. Hope Bays. Narragansett Marine Laboratory, Graduate School of Oceanography, University of Rhode Island. Kingston, RI.

Abstract: A comprehensive bottom surface sediment sampling program was completed in Upper Narragansett and Mt. Hope Bays. The textural composition of these samples as characterized by the proportions of gravel, sand, silt, and clay has provided a basis for the preparation of a general sediment distribution map for this area.

McMaster, R.L. and L.E. Garrison. 1967. A Submerged Holocene Shoreline Near Block Island, Rhode Island. Graduate School of Oceanography, Narragansett Marine Laboratory, University of Rhode Island. Kingston, R.I.

Abstract: A drowned barrier spit-lagoon-headland complex has been located south of Block Island, Rhode Island at a depth of about 80 feet. The morphology of these submerged shoreline features is similar to that of features occurring on the Rhode Island coast at present. If isostatic adjustments have been insignificant in this area, the drowned features were related to a sea level still stand at an estimated 80 feet below present sea level. A changing pattern of sediment types and structures across this shoreline was observes from a submarine.

McMaster, R.L., T.P. Lachance, and L.E. Garrison . 1968. Seismic-reflection Studies in Block Island and Rhode Island Sounds. Narragansett Marine Laboratory, University of Rhode Island. Kingston, RI .

Abstract: Continuous seismic-reflection profiles reveal a south-southeast-dipping Fall Zone surface on which deposits of probable Late Cretaceous age occur. A distinct cuesta and inner lowland, which mark the inshore edge of these deposits, are traceable across the sounds between Long Island and Martha's Vineyard area. Post-Cretaceous erosion cycles produced a well-defined drainage system on the Fall Zone surface and coastal plain formations. The locations of many of the linear depressions on the present bottom surface of the sounds are closely related to these post-cretaceous valleys. Glacial events have had minimal effect on this inner shelf although locally thick Pleistocene deposits may be present in the inner lowland. Finally, thin accumulations of post-glacial sediments overlie a distinctive erosion of late Wisconsin or early Holocene age.

MCZM. 2001. Massachusetts Coastal Zone Management Massachusetts Board of Underwater Archaeological Resources Exempt Shipwreck List . http://www.state.ma.us/czm/buares.htm.

Abstract: This website, maintained by the Massachusetts Coastal Zone Management Agency, lists all shipwrecks that have been protected by the agency specifically for recreational diving.

Means, J.C. and A.E. McElroy. 1997. Bioaccumulation of Tetrachlorobiphenyl and Hexachlorobiphenyl Congeners by *Yoldia limatula* and *Nephtys incisa* from Bedded Sediments: Effects of Sediment- and Animal-related Parameters. Environmental Toxicology and Chemistry. 16(6):1277-1286.

Abstract: Sediments from Narragansett Bay (RI, USA) were fortified with two chlorobiphenyl congeners, 2,4,2',4'-tetrachlorobiphenyl (IUPAC 47) and 2,4,5,2',4',5'-hexachlorobiphenyl (IUPAC 153), and equilibrated for various times up to 30 d to assess the bioaccumulation potential of sediment-sorbed polychlorinated biphenyls by the benthic invertebrates Yoldia limatula and Nephtys incisa. Bioaccumulation was investigated at steady state and using a single-compartment kinetic model over exposure periods of up to 6 d for Nephtys and 30 d for Yoldia. Normalization of exposure and tissue accumulation data to hydrophobic reservoirs yielded accumulation factors (AFs) that fell within model prediction ranges. However, persistent, statistically different values of AFs were obtained from sediments with varying organic carbon contents. Growth of the organisms, feeding strategies, and lipid content were all significant variables in interpreting wet weight steady-state accumulation. Kinetically determined AF values were not statistically different from those measured at steady state. A role of interstitial water colloidal organic matter in mediating bioaccumulation was strongly suggested by the results.

Meguire, R.E. 1971. Tidal Currents and Water Exchanges in Western Block Island Sound.

Meng, L., C. Gray, B. Taplin, and E. Kupcha. 2000. Using Winter Flounder Growth Rates to Assess Habitat Quality in Rhode Island's Coastal Lagoons. Marine Ecology Progress Series. 201:287-299.

Abstract: We used growth rates of juvenile winter flounder Pseudopleuronectes americanus, to assess habitat quality in 3 of Rhode Island's coastal salt ponds that had differing levels of nutrients and human development. In each pond, 1 m super(2) cages were placed in vegetated and unvegetated habitats and growth rates of individually marked fish were measured in three 10 to 15 d experiments from 4 June to 7 July 1997. Water temperature, salinity, dissolved oxygen, and benthic food were also measured. Stable isotopes of C and N were measured in experimental and wild fish. Growth rates were 0.06 to 0.76 mm/d and decreased through the experiments. Growth rates of wild fish (0.19 mm/d in Point Judith Pond and 0.21 in Ninigret Pond) were similar to the average of the 2nd and 3rd experiments (0.24 mm/d). Growth rates were the same in vegetated and unvegetated sites. They were also the same in Point Judith and Ninigret ponds but lower in Green Hill Pond. An ANCOVA suggested that Green Hill's lower rates were caused by its higher temperatures, particularly during the 3rd experiment. Benthic food was similar in the different ponds, different habitat types, and in cores taken inside and outside cages. Categories of food consumed by fish were not affected by the presence of vegetation in a cage, although food consumed did differ from pond to pond. Amphipods were the preferred food in all ponds; fish consumed proportionately more amphipods and fewer polychaetes in Ninigret Pond than in the other ponds. Values of delta super(15)N in the fish varied with the degree of development in the watershed but not with total nitrogen in the water column. The results of this study indicate that growth rates of fish can be used as indicators of habitat quality.

Meng, L. and J.C. Powell. 1999. Linking Juvenile Fish and their Habitats: An Example from Narragansett Bay, Rhode Island. Estuaries. 22(4):905-916.

Abstract: We used two methods and existing field survey data to link juvenile fish and their habitats. The first method used seine survey data collected monthly from July to October 1988-1996 at fixed stations in Narragansett Bay, Rhode Island. Thirteen fish species making up 1% or more of the catch were analyzed by principal components analysis for two time periods: July-August and September-October. The stations were then plotted by their principal component scores to identify station groupings and habitat types. The second method used environmental data collected in July and August 1996 at the established survey stations in a principal components analysis. The stations and 13 most abundant species were plotted by principal components scores resulting from the environmental data. For the environmental data, the first

two principal components explained 59% of the variance. The first principal component described the amount of energy shaping the habitat and was positively correlated with salinity, dissolved oxygen, current flow, and slope, and negatively correlated with silt. The second component was positively correlated with depth and silt, and negatively correlated with dissolved oxygen. The environmental data grouped the stations according to their distance from the ocean and three habitat types emerged. The uppermost station was a silty barren having low salinities and dissolved oxygen. Three other stations grouped together as low energy, protected habitats with sandy substrates. Lower bay stations had higher salinities, higher dissolved oxygen, higher flow rates, greater slopes, and larger size substrates, mostly cobble and gravel. Results from the fish data grouped the stations similarly. Combining results from both datasets revealed the uppermost station had the highest catches, most species, and greatest number of winter flounder (Pseudopleuronectes americanus) juveniles. Plots of winter flounder catches with principal component scores from the environmental data indicated the winter flounder distribution in the bay has shrunk from baywide to mostly the upper estuary near their primary spawning grounds. Results illustrate the value of coupling historic fish survey data with environmental measurements for identifying previously undervalued habitats important to fish.

Meng, L., J.C. Powell, and B. Taplin. 2001. Using Winter Flounder Growth Rates to Assess Habitat Quality across an Anthropogenic Gradient in Narragansett Bay, Rhode Island. Estuaries. 24(4):576-584.

Abstract: We used growth rates of juvenile winter flounder *Pseudopleuronectes americanus* to assess anthropogenic influence on habitat quality at three sites in Narragansett Bay, Rhode Island. The upper bay site, Gaspee Point, had the highest population density and concentration of total nitrogen; human inputs decreased down bay. Growth rates of individually marked fish were measured in three 15-d experiments from June 8 to July 6, 1998 in 1-m² cages placed at upper, middle, and lower bay sites. Water temperature, salinity, dissolved oxygen (DO), and benthic food were also measured. Stable isotopes of nitrogen and carbon were measured in experimental fish as possible indicators of nutrient enrichment and to identify organic carbon sources. Growth rates were 0.22-0.60 mm d^{-1}, with the highest average at the mid-bay site. Growth was initially fastest at Gaspee Point, but dropped off as DO concentrations fell. Step-wise multiple regression indicated that location (upper, middle, or lower bay) explained most of the variability in fish growth (40%). Coefficients of other significant variables indicated that fish grew faster at lower salinities, smaller sizes, and with decreased time that DO was below 2.3 mg l^{-1}. Benthic prey varied among sites and there was significantly less food and fewer species at Gaspee Point. *Polydora cornuta* was a favored food at all sites and was found in over half the stomachs. Values of $\delta^{15}N$ in fish and sediments did not reflect differences in total nitrogen concentrations recorded near the sites. We suggest that anthropogenic influences, such as nutrients and sewage, affected habitat quality by reducing DO, which lowered fish growth rates.

Metcalf & Eddy. 1987. Designation of Dredged Material Disposal Site(s) for Rhode Island and Southeastern Massachusetts. Task 3. Historical Overview. Prepared for U. S. Environmental Protection Agency Region 1. Metcalf & Eddy.

Metcalf & Eddy. 1987. Designation of Dredged Material Disposal Site(s) for Rhode Island and Southeastern Massachusetts. Task 6 – Delineate Zone of Siting Feasibility for Disposal. Prepared for US Environmental Protection Agency Region 1. Metcalf & Eddy.

Abstract: Various Zones of Siting Feasibility have been constructed within the Rhode Island and Southern Massachusetts study area. These include potential upland, near shore and ocean disposal areas. The study area has been divided into 3 separate panels each showing the Zones of Siting Feasibility as well as the Territorial Sea boundaries. Based on total cost estimates an upland disposal site is feasible within approximately 5 miles of the coastline at an expenditure of $10.00/$yd^3$. Based on available cost estimates an ocean disposal site approximately 5 miles from the Territorial Sea boundary would be feasible from all regions in the study area for between $7.00/$yd^3$ and $8.00/$yd^3$ total cost. Finally, based on a total cost

expenditure of $10.00/yd^3 ocean disposal could take place approximately 60 miles from the major areas of potential dredging need. This represents the outer limit of a zone for future siting of an ocean disposal site given an expenditure of $10.00/yd^3.

Metcalf & Eddy. 1987. Designation of Dredged Material Disposal Site(s) for Rhode Island and Southeastern Massachusetts. Task 7. Identify Initial Screening Criteria for Sites and Methods. Prepared for U. S. Environmental Protection Agency Region 1. Metcalf & Eddy.

Abstract: Initial screening criteria to assist in formulating dredged material disposal alternatives are identified. The criteria are designed to specify existing conditions which if present in an area would renter that area unsuitable for disposal. Examples of this process are presented for criteria where data exist to make this determination. Additional data and investigations would be required to apply the other criteria.

Michael, A.D. 1975. Structure and Stability in Three Marine Benthic Communities in Southern New England. Pages 109-125 In: Manowitz, B., (Ed.), Effects of Energy-Related Activities on the Atlantic Continental Shelf. Brookhaven National Lab, Upton, NY.

Abstract: The pressure to exploit a variety of resources in the marine environment presents the ecologist with the problem of monitoring ecosystems to evaluate the impact of such activities. The fundamental issue of what should be measured and how the determinations should be made remains unanswered or at least in dispute. Benthic ecology is not a well-developed science since it has not received much attention in the past. In many areas a benthic monitoring project must start with the fundamentals of describing the species that exist in the region and their approximate abundances. The data available are insufficient for developing a firm theoretical basis to explain the distribution and abundances of the benthic fauna. Community processes such as energy transfer or nutrient cycling within the benthos are not understood. We do not know which parameters of marine benthic communities can be most accurately measured, or what the controlling factors are, although we may extrapolate from other areas of marine ecology. It is obvious that both physical and biological factors affect species distributions, but their relative importance in various situations is not understood.

In attempting to monitor a benthic community, should one measure community parameters such as diversity, species richness, equitability, *etc.* or should one concentrate on documenting individual species responses? Could this time-consuming work of identification and sorting be avoided by simply estimating rates of various processes such as oxygen uptake, nitrogen regeneration, etc? The literature is much too scant in the latter area for any evaluation of its potential for monitoring purposes. Even the basic numerical data that exist for the benthos may not be sufficient for a clear statement. In spite of all these problems, some significant advances have been made in the last few years. I will discuss some of these in an overview of some recent data from three nearshore areas, Long Island Sound, Buzzards Bay, and Cape Cod Bay.

Miller, G.R. 1974. A Survey of the Available Information on Toxic Materials in Narragansett Bay. Graduate School of Oceanography, Narragansett Marine Laboratory, University of Rhode Island. Kingston, RI.

Abstract: The Narragansett Bay drainage area encompasses most of Rhode Island, except for the southwest section of the state, and a large portion of Massachusetts. The wastes of approximately 90 percent of the homes and almost all of the industry eventually drain into the estuary (Governor's Technical Committee on the Coastal Zone, 1970). These discharges, as well as the commercial and recreational traffic in the Bay, are the major sources of the toxic materials to be considered. The objectives of this report are to summarize the available information on toxic substances and indicate, where sufficient information is available, those materials which may have a harmful effect on the biota of the estuary. Those areas where there is insufficient information and where more data are highly desirable are also indicated.

Miller, J.E., J.S. Ferguson, and J.S. Byrne. 1996. Use of an Integrated Hydrographic Survey System in Long Island Sound and Vineyard Sound. The Hydrographic Journal. 80:17-22.

Abstract: SAIC's Integrated Hydrographic Survey System (IHSS) was used to conduct hydrographic surveys of Long Island Sound, New York, and Vineyard Sound, Massachusetts. As part of the IHSS, a Reson multibeam sonar was selected as the primary depth measurement tool; engineering tests of this instrument showed that the depth soundings met or exceeded International Hydrographic Organization standards. The IHSS combines state-of-the-art data collection and processing tools for analysis of multibeam and side-scan sonar data, providing innovative techniques to combine multibeam and side-scan data as well as to produce standard hydrographic products such as junction analyses and smooth sheets.

Miller, J.E., J.S. Ferguson, J.S. Byrne, and W.S. Simmons. 1996. Shallow Water Multibeam Hydrography to IHO Standards. Sea Technology. 37(6):81-86.

Abstract: SAIC conducted hydrographic surveys April through October, 1995, in support of nautical charting under contract for the National Oceanic and Atmospheric Administration's (NOAA) Nautical Charting Branch, Office of Coast Survey. These surveys, in Long Island Sound and Vineyard Sound (off the coasts of New York and Massachusetts), were run using SAIC's integrated hydrographic survey system (IHSS) in conjunction with a RESON Inc. (Goleta, California) SeaBat multibeam sonar and a Klein Associates Inc. (Salem, New Hampshire) side-scan sonar in water depths of 2.7 to 60 meters. Requirements included 100 percent multibeam-sonar bottom coverage meeting International Hydrographic Organization (IHO) standards (1 x IHO) to a swath width of 45 degree and twice IHO standard (2 x IHO) at greater usable widths, 200 percent side-scan sonar coverage, and detection of all significant features.

Monaco, M.E. and R.E. Ulanowicz. 1997. Comparative Ecosystem Trophic Structure of Three U.S. Mid-Atlantic Estuaries. Marine Ecology Progress Series. 161:239-254.

Abstract: Quantitative networks of trophic exchanges offer the potential to compare food webs from neighboring ecosystems in order to ascertain whether large differences and similarities exist in trophic structure and function. Network analysis was invoked to compare the exchanges of carbon in 3 mid-Atlantic estuaries on the eastern U.S. coast: the Narragansett, Delaware, and Chesapeake Bays. Narragansett Bay exhibited the highest average annual rate of net primary production, followed by Delaware and Chesapeake Bays. Taken in combination, the analyses of cycling structures (magnitude of flows, average carbon cycle lengths), organization of carbon flows, system production:biomass ratios, and harvest rates all indicated that the Delaware and Chesapeake Bay ecosystems are more stressed than that of Narragansett Bay. To differentiate between the former two, a combination of measures of system efficiency, cycling structure, and food web connectivity was employed. The results indicated that Delaware Bay is currently less impacted and has potentially more ability to mitigate perturbations to its food web than does Chesapeake Bay. Overall, network analysis proved to be a suitable methodology for making inter-estuarine ecosystem comparisons, and for providing useful insights to natural resource managers in the assessment of estuarine trophic structure and status.

Monosson, E. and J.J. Stegeman. 1991. Cytochrome P450E (P450IA) Induction and Inhibition in Winter Flounder by 3,3',4,4'-tetrachlorobiphenyl: Comparison of Response in Fish from Georges Bank and Narragansett Bay. Environmental Toxicology and Chemistry. 10(6):765-774.

Abstract: Induction of liver microsomal cytochrome P450 by 3,3',4,4'-tetrachlorobiphenyl (TCB) was evaluated in winter flounder from two different sites, one offshore (Georges Bank) and one coastal (Narrow River, Narragansett, Rhode Island). Immunoblot analysis of liver microsomes with monoclonal antibody 1-12-3 to scup P450E (P450IA1) revealed P450IA protein content of 0.01 nmol/mg in Georges Bank fish that were not treated with TCB. By comparison, untreated Narrow River fish had an 80-fold greater content of immunodetected P450IA protein, indicating a strong environmental induction in these fish. In Georges Bank fish the total (spectrophotometrically measured) microsomal P450 content and the content of P450IA protein were induced progressively by intraperitoneal doses of TCB ranging from 0.1 to 10.0 mg/kg.

Ethoxyresorufin-O-deethylase (EROD) specific activity (activity per mg protein) was also progressively induced, but the catalytic efficiency or turnover number (*i.e.*, activity/nmol P450IA) was less in fish given the greater doses of TCB.

Moor, S.R. 1987. Inventory of Local Regulations Pertaining to Water Quality in Buzzards Bay. BBP-88-01. Buzzards Bay Project. U.S. Environmental Protection Agency. Boston, MA.

Abstract: This project involved the collection, summarization, and comparison of municipal laws and regulations of the sixteen communities within the Buzzards Bay drainage basin. These laws were analyzed for water quality protection provisions. Point sources of water pollution are not addressed within this report, because they are regulated by the National Pollutant Discharge Elimination System (NPDES) permit process. This analysis has allowed us to describe what is being regulated by municipalities and what is regulated primarily by the state, as well as to detail how these regulations vary among communities. Our comparisons have allowed us to identify some of the strengths and weaknesses of these local regulations. This will lead the way for suggested improvements in local means of water quality protection and water resources management.

Moore, G. and S. Jennings. 2000. Commercial Fishing: The Wider Ecological Impacts. Blackwell Science. London.

Abstract: Fisheries provide food, income and employment for 200 million people. Fishing gears are designed to catch edible and marketable fish or shellfish, but they also catch non-target species and damage marine habitats. The direct effects of fishing have indirect effects on the structure and function of marine ecosystems. We need to know the causes and consequences of fishing effects in order to apply valid conservation measures. These will help guarantee long-term yields of food and income from fisheries while minimizing their environmental impact.

Morang, A. and R.L. McMaster. 1978. A Study of Nearshore Processes along the Southwestern Rhode Island Shoreline based upon Side Scan Sonar Surveys: Final Report, Coastal Resources Management Council, State of Rhode Island. University of Rhode Island, Graduate School of Oceanography. Narragansett, RI.

Abstract: A Klein side scan sonar system was used to survey the sea floor of the nearshore zone adjacent to the southwest Rhode Island beaches between Matunuck and Watch Hill Points on a seasonal basis from April '77 to April '78. Large scale features were seen along with bedforms including ripples, megaripples, and sand waves. The presence of shoreward facing asymmetrical sand waves suggests that these features develop and migrate in response to long period southwest swell and thereby return sand to the beaches under these wave conditions. During a southwest storm in particular and probably intense storms in general sand is moved seaward by rip currents which form strips of megaripple covered sand, trending perpendicular to the shore. Although the bottom features indicate a few nearshore bottom circulation cells exist off Misquamicut, parts of East Moonstone and Green Hill beaches, no nearshore bottom circulation pattern emerges that characterize the coastline between Matunuck and Watch Hill Points during either storm or non storm conditions. However, under conditions of an eastward excursion of east-flowing longshore currents along the entire shoreline, the currents may meander in the area between the Charlestown Inlet and Matunuck Point, with each undulation being about 1km long.

Moring, J.R., O. van den Ende, and K.S. Hockett. 1999. Predation on Atlantic Salmon Smolts in New England Rivers. Pages 127-139 In: McCormick, S. and D. MacKinlay, (Eds.), Smolt, Physiology, Ecology and Behaviour. Proceedings of the International Congress on the Biology of Fish.

Abstract: Restoration of extirpated populations of Atlantic salmon (*Salmo salar*) in New England has been a slow process with mixed results. Survival between the smolt stage and adult return has been extremely low in southern New England rivers and only somewhat higher in Maine waters. One source of mortality is riverine predation on migrating smolts by fishes and birds. Recent predation studies in New England

provide evidence of significant mortality in the smolt stage, prior to reaching the ocean. Known predators of Atlantic salmon smolts in rivers of New England and eastern Canada include at least 6 species of birds and as many as 11 species of freshwater fishes. The results of predation studies in New England are reviewed with particular emphasis on recent studies in Maine. Field studies confirm bioenergetics model predictions that chain pickerel (Esox niger) are potentially major predators during the early portions of smolt runs, when water temperatures are lower. Overall, small mouth bass (Micropterus dolomieu) may not be significant predators, except during warmer water temperatures or below artificial structures where smolts are especially vulnerable. Predation of smolts by double-crested cormorants (Phalacrocorax auritus) along the Penobscot River was highest near dams; an average of 7.3% of hatchery smolts may be consumed by cormorants each year in the River. A recent study is discussed that may result in reduced predation on stocked fry and smolts. This involves reinforcing the anti-avian predator response while in the hatchery. Fish experiencing regular startle responses and accessibility to, at least, limited types of cover exhibited greater predator-avoidance behavior once stocked in a stream.

Morreale, S.J. and E.A. Standora. 1992. Habitat use and feeding activity of juvenile Kemp's ridleys in inshore waters of the northeastern U.S. NOAA Tech. Memo. NMFS-SEFC-302. Pages 75-77 (Salmon and J. Wyneken), Proceedings of the Eleventh Annual Workshop on Sea Turtle Biology and Conservation. 195.

Abstract: This research represents one of the few sea turtle studies in which dietary composition was directly compared with resource availability. Our preliminary findings suggest that relative abundance of available crab species is not the primary factor governing prey selection by the Kemp's ridley turtles in New York waters. The species composition in the feces was very different than was observed overall among the sampling sites. While it is possible that the turtles are choosing the few sites in which spider and rock crabs are more abundant, this was an unlikely scenario. During this study, turtles were captured at different sites throughout the sampling area. Moreover, our simultaneous telemetry studies showed that turtles move easily among all the sites. In addition, four of the study animals whose movements were constantly monitored spent little or no time in the spider crab rich areas.

Morton, R.W. 1967. Spatial and Temporal Observations of Suspended Sediment: Narragansett Bay and Rhode Island Sound. Naval Underwater Weapons Research and Engineering Station. Newport, RI.

Abstract: The installation and operation of underwater test ranges requires a through understanding of the marine environment so that the effects of the sea on test or evaluation of ordnance may be assessed. This report has three purposes 1) To determine the effect of the estuarine environment on the total transport of material to the sea by studying the sediment transport in a typical estuary and correlating this with various physical parameters; 2) To determine the sedimentary processes that affect the bottom of the NUWS test ranges and cause variations in reverberation; 3) To define more clearly the regional circulation patterns that affect such physical parameters of sea water as temperature, salinity, and sound velocity by studying the transport of sediment in the test range area.

Moskovits, G. 1951. Preliminary Studies on Some Aspects of Bacteria-Plankton Relations in Vineyard Sound.

Abstract: A study has been made of the fluctuations of bacteria in the seawater and those attached to the plankton, with seasonal fluctuations of plankton in Vineyard Sound from January to May 1951. Zooplankton and phytoplankton samples were collected using the Clarke-Bumpus sampler, and plankton counts were made. Water samples were collected in sterile bottles from several depths. The bacteria both in the water and attached to the plankton were evaluated by the standard plate method using ZoBell's Medium 2216. A method was devised for obtaining higher bacteria counts from the plankton than could otherwise be obtained, by grinding up the plankton organisms in a Waring blender and plating out the ground up samples. Inconsistencies in the resultant plate counts led the writer to believe that bacteria from places other than the outer surfaces of the plankton organisms were also being evaluated. Theories have

been advanced to explain these inconsistencies. The failure of the grinding procedure led to the use of plate counts from the untreated plankton samples. Living zooplankton organisms were embedded in nutrient agar medium, and the resulting bacterial growth observed and photographed.

The numbers of bacteria in the seawater were found to vary directly with the numbers of zooplankton organisms; but a definite trend could not be detected for the water bacteria and the phytoplankton. The numbers of periphytic bacteria associated with the zooplankton and with the phytoplankton were found to vary directly with the plankton numbers; but there was greater agreement in the case of the zooplankton than in the case of the phytoplankton. More bacteria were found to be associated with the phytoplankton organisms per unit volume of water than with the zooplankton organisms. In addition, it was calculated that there were more bacteria associated with each zooplankton organism than with each phytoplankton organism; for both the zooplankton and the phytoplankton organisms the numbers of bacteria per plankton organism varied inversely with the numbers of plankton organisms. The bacterial growth experiments showed that bacteria were definitely associated with the plankton organisms.

Moss, S.A. and J. Hoff. 1988. The Finfish Resources of Buzzards Bay. Buzzards Bay Project Report. Southeastern Massachusetts University. North Dartmouth, MA. 56 pp + appendices.

Moss, S.A., J.G. Hoff, and F.X. O'Brien. 1981. Forecasting Fish Entrapment by Velocity Cap Intakes: A Comparative Approach. Pages 183-198 In: Jensen. L.D., (Ed.), Issues Associated with Impact Assessment, Proceedings of the Fifth National Workshop on Entrainment and Impingement. EA Communications, Sparks, MD.

Abstract: Offshore velocity cap intakes represent a state-of-the-art technology for large cooling-water systems. At the present time, operational oceanic intakes of this type exist only in Florida and southern California. Future coastal power plant installations may utilize this intake design in other regions, but their performance relative to fish entrapment will be uncertain.

This report deals with the performances of the several operational coastal velocity cap intakes and identifies a number of factors affecting their entrapment of fishes. These include intake design and location, weather and sea conditions, and the behavioral and ecological characteristics of the fishes available for entrapment. This information is applied to the abiotic and biotic conditions existing on the southern New England coast to forecast the effectiveness of the velocity cap design and to suggest areas of needed environmental data.

Munns, W.R., Jr., C. Mueller, D.J. Cobb, T.R. Gleason, G.G. Pesch, and R.K. Johnston. 1991. Marine Ecological Risk Assessment at Naval Construction Battalion Center, Davisville, Rhode Island, Phase I. Technical Report 1437. Naval Ocean Systems Center. San Diego, CA.

Abstract: Allen Harbor, located in Narragansett Bay at NCBC Davisville, was closed to shellfishing by the Rhode Island Department of Environmental Management because of suspected hazardous waste contamination from a landfill and disposal area adjacent to the harbor. A 15-acre landfill received a wide variety of wastes, including sewage sludge, solvent, paints, chromic acid, PCB-contaminated waste oils, preservatives, blasting grit, and other municipal and industrial wastes generated at NCBC Davisville and at the Naval Air Station (NAS) Quonset Point between 1946 to 1972. Another site, also adjacent to Allen Harbor on Calf Pasture Point, was used for the disposal of calcium hypochlorite decontaminating solution and chlorides.

A phased approach was developed to assess the ecological risks to Allen Harbor and Narragansett Bay posed by these hazardous waste sites. This report covers Phase I, the collection of environmental data that characterize the natural resources, sediment and water quality, and toxicology of indigenous and feral marine organisms of Allen Harbor and nearby Narragansett Bay. These data were evaluated to determine if there were adverse ecological effects from the disposal sites.

Murawski, S.A. 1993. Factors Influencing By-catch and Discard Rates: Analyses from Multispecies/Multifishery Sea Sampling. Journal of Northwest Atlantic Fishery Science. 19:31-39.

Abstract: Factors associated with the species composition and magnitude of bycatch and discarding were evaluated, based on multifishery sea sampling data. Data used were from the mixed species otter trawl fisheries of the Georges Bank-Southern New England sampled during 1989-1992. A total of 4,533 otter trawl tows were sampled. General linear models of main effects related discard rates, total catch and indices of species richness, diversity and evenness to temporal, spatial and operational variables associated with the fishing process (year, month, statistical area, primary species sought, cod-end mesh size, vessel size, tow duration, total catch, total discards, depth). Discarding rates (proportion of the catch discarded) varied significantly both for individual species and for aggregate species by year, area, month, and target species. The species composition and diversity of catches was a significant function of categorical variables as well as mesh size and tow duration.

Murawski, S.A., J.W. Ropes, and F.M. Serchuk. 1982. Growth of the Ocean Quahog, *Arctica islandica*, in the Middle Atlantic Bight. Fishery Bulletin. 80(1):21-34.

Abstract: In situ growth rate of the ocean quahog, *Arctica islandica*, was investigated at a site 53 m deep off Long Island, New York, during 1970-80. Specimens notched during summer 1978 and recaptured 1 and 2 calendar years later yielded information on shell growth and the periodicity of supposed annual marks. Growth of specimens recaptured after 1 year at liberty (n=67, 59-104 mm shell length) was described by SL_{t+1} =2.0811+0.9802 SL_t , where SL is shell length in millimeters at age t. Average shell length of marked specimens recaptured during summer 1980 increased 1.17 mm (n=200), approximately twice that of ocean quahogs recaptured in 1979 (0.56 mm). Band formation on the external surface of small ocean quahogs (less than about 60 mm) was apparently an annual event since small specimens recaptured in 1979 formed one such mark during the interval between release and recapture. Small specimens sampled during summer exhibited relatively wide marginal growth from the last external mark to the shell edge, while winter samples had formed new annuli at the shell margin, thus, external bands were formed during early autumn-early winter. Internal banding in shell cross-sections of small ocean quahogs correlated in number and position with external features. An equation representing back-calculated growth, based on external banding patterns of small unmarked specimens (19-60 mm) captured during summer 1978, was: SL=75.68-81.31 $(0.9056)^t$, where t is age in years. Length-frequency samples were available for the vicinity of the marking study from routine dredge surveys of clam resources during 1970-80. Growth rates inferred from progressions of length-frequency modes in 1970 and 1980 samples were similar to those computed from mark-recapture and age-length equations. Ocean quahogs are apparently among the slowest growing and longest lived of the continental shelf pelecypods; annual increases in shell length were 6.3% at age 10, 0.5% at age 50, and 0.2% at an estimated age of 100 years.

Murawski, W.S. 1969. A Study of Submerged Dredge Holes in New Jersey Estuaries with Respect to their Fitness as Finfish Habitat. New Jersey Fish and Game. Trenton, NJ. 32 pp.

Abstract: Thirty-eight submerged dredge holes located in New Jersey estuaries were examined with respect to their fitness as finfish habitat. Water quality parameters examined were temperature, salinity, dissolved oxygen concentration and hydrogen sulfide concentration. The bottom muds of 33 of these holes were examined for their invertebrate fauna. Of the 38 holes, 21 had dissolved oxygen and/or hydrogen sulfide conditions in their bottom waters that could not sustain healthy fish life. Of the 33 holes examined for invertebrate fauna, 20 or approximately 60% lacked any bottom invertebrates. Further, analysis of the bottom muds from six dredge holes for some of their physciochemical properties revealed that the highest amounts of organic matter and the highest concentrations of soluble ferrous and manganese ions in the muds were associated with stagnant holes.

The reasons given for the cause of stagnation of these holes are as follows: too great a depth in relation to the surrounding water, intrusion of poor quality ground water, abnormally high accumulation of detritus and prevention of mixing by the wind because of the sheltering effect of the shoreline.

Although the formation of stagnant or semi-stagnant holes is not recommended some were of benefit in that they retained the warm water of the fall months, thus providing a concentrating effect on the fish at mid-depths in winter, which is of value to the angler.

MWDC. 2001. Metrowest Dive Club New England Shipwreck Diving Information . http://www.mwdc.org.

Narragansett Bay Project. 1989. The Narragansett Bay Project Progress Report: Pollutant Trends in Narragansett Bay. Narragansett Bay Project. Providence, RI.

Abstract: This is a report on the status of Narragansett Bay and the Narragansett Bay Program around 1985 and 1986. Includes general public relations type descriptions of water quality, sediment quality, and fish and shellfish quantity/quality throughout the bay.

Narragansett Marine Laboratory. 1955. Marine Sedimentation Project, Progress Report, 1 March 1955 - 31 August 1955. Narragansett Marine Laboratory, University of Rhode Island. Narragansett, RI.

Abstract: A progress report on sedimentation studies being conducted in an area of Narragansett Bay. A detailed description of the tasks that have been fulfilled to date, both field research and laboratory analysis.

Narragansett Marine Laboratory. 1955. Marine Sedimentation Project, Progress Report, 1 September 1954 - 28 February 1955. Narragansett Marine Laboratory, University of Rhode Island. Narragansett, R.I.

Abstract: A progress report on sedimentation studies being conducted in an area of Narragansett Bay. A detailed description of the tasks that have been fulfilled to date, both field research and laboratory analysis.

Narragansett Marine Laboratory. 1954. Marine Sedimentation Project Progress Report, 31 August 1953 - 28 February 1954. Narragansett Marine Laboratory, University of Rhode Island. Narragansett, R.I.

Abstract: A progress report on sedimentation studies being conducted in an area of Narragansett Bay. A detailed description of the tasks that have been fulfilled to date, both field research and laboratory analysis.

National Marine Fisheries Service. 2001. Fisherman's Report. Fall Bottom Trawl Survey. Cape Hatteras - Gulf of Maine September 4-October 23, 2001. National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Woods Hole, MA. http://www.nefsc.nmfs.gov/nefsc/publications/ .

Abstract: A listing and series of geographical plots of important commercial and recreational species caught during the Northeast Fisheries Science Center's 2001 fall bloom trawl survey aboard the *FRV ALBATROSS IV*. Thirty-minute tows were made with a Yankee otter trawl at a random selection of station locations. Data are summarized from unaudited catch files generated by the Fisheries Scientific Computer System.

National Marine Fisheries Service. 2001. Fisherman's Report. Sea Scallop Survey. NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center. Woods Hole, MA. www.nefsc.nmfs.gov/esb/fishermens%20reports.htm.

Abstract: The following charts and station data indicate the distribution of sea scallops during the 2001 summer Scallop Survey. Fifteen-minute tows were made at a speed of 3.8 knots using a standard 8-foot New Bedford type scallop dredge. The dredge was equipped with a 2-inch ring chain bag and lined with 1-1/2 inch mesh webbing to retain small scallops. For statistical purposes, stations were randomly selected and therefore were not always on or near scallop concentrations. In this report, scallop catch is reported in numbers and by-catch is recorded in bushels, depth in fathoms and bottom temperature in degrees

Fahrenheit. Bottom temperature is included at selected stations because it is an environmental factor, which influences growth rates and spawning time. Catches are reported in three categories of shell height: less than or equal to 90mm (greater than 40 count), greater than 90mm (less than 40 count), and greater than or equal to 100mm (less than 30 count). The percent composition of by-catch is also given. The data are summarized from unaudited catch files. Therefore, all information in this report is considered provisional and subject to change.

National Marine Fisheries Service. 2001. Fisherman's Report. Spring Bottom Trawl Survey Cape Hatteras - Gulf of Maine February 26 April 30, 2001. National Oceanographic and Atmospheric Administration,

National Marine Fisheries Service, Northeast Fisheries Science Center. Woods Hole, MA. http://www.nefsc.nmfs.gov/nefsc/publications/.

Abstract: A listing and series of geographical plots of important commercial and recreational species caught during the Northeast Fisheries Science Center's 2001 Spring bloom trawl survey aboard the *FRV ALBATROSS IV*. Thirty-minute tows were made with a Yankee otter trawl at a random selection of station locations. Data are summarized from audited catch files generated by the Fisheries Scientific Computer System.

National Marine Fisheries Service. 1997. Fishermen's report, fall bottom trawl survey, preliminary catch summary, Cape Hatteras - Gulf of Maine, September 9 - October 30, 1997. Resource Surveys Branch, Northeast Fisheries Science Center.

Abstract: The enclosed listed and plotted data are of commercially and recreationally important species caught during the Northeast Fisheries Science Center's 1997 fall bottom trawl survey aboard R/V ALBATROSS IV out of Woods Hole, MA. Tows were made with a #36 otter trawl rigged with rollers, 5-fathom legs and 1000 pound polyvalent doors. The codend and upper belly were lined with a 1/2-inch mesh liner to retain young-of-the-year fish.

This fall, 30 special tows were made in and near Closed Area 2 (Great South Channel area), in an effort to monitor finfish distribution and abundance within this important area. Catch data from these tows (numbers 340-369) are included in this report.

Because of the 30-minute tow duration, and random selection of station locations, catches can be light compared to commercial tows. Also, vessel operations are on a 24-hour basis and catches have not been adjusted for day/night catchability differences. Nevertheless, these data can provide fishermen with useful information about distribution and relative abundance throughout the survey area (Cape Hatteras to the Gulf of Maine).

National Marine Fisheries Service. 2001. Fishermen's Report. Winter Bottom Trawl Survey. Cape Hatteras - SE Georges Bank January 29-February 23, 2001. National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Woods Hole, MA. http://www.nefsc.nmfs.gov/nefsc/publications/.

Abstract: A listing and series of geographical plots of important commercial and recreational species caught during the Northeast Fisheries Science Center's 2001 Winter bloom trawl survey aboard the *FRV ALBATROSS IV*. Thirty-minute tows were made with a Yankee otter trawl at a random selection of station locations. Data are summarized from unaudited catch files.

National Marine Fisheries Service. 2002. "Guide to Essential Fish Habitat Designations in the Northeastern United States". *NOAA/National Marine Fisheries Service* .www.nero.nmfs.gov/ro/STATES4/massri.htm.

Abstract: Summary of Essential Fish Habitat (EFH) designation in 10' × 10' square coordinates south of Cape Cod and Rhode Island.

National Marine Fisheries Service. 1998. Letter Correspondence from Mike Ludwig, NMFS to Richard Reardon, U.S. Army Corps of Engineers, February 13, 1998.

Abstract: This letter was written to the USACE by Mike Ludwig to document his review of the endangered and threatened species lists for the Providence River and Harbor Dredging Project. The letter identifies which species Mr. Ludwig felt should be addressed in a biological assessment of the project.

National Marine Fisheries Service. 1988. Northeast Research and Management Plan for the Ridley Sea Turtle. National Marine Fisheries Service, Management Division, Habitat Conservation Branch. Gloucester, MA.

National Ocean Survey. 1971. Block Island Sound and Eastern Long Island Sound; Tidal Current Charts. 1st ed. National Ocean Survey. Rockville, MD.

Abstract: These charts present a comprehensive view of the hourly speed and direction of the current in Block Island Sound and Eastern Long Island Sound including the Thames and Connecticut Rivers. They also provide a means for determining the speed and direction of the current at various localities throughout the Sounds. The arrows show the direction of the current; the figures give the speed in knots at the time of spring tides, that is, during the time of new or full moon when the currents are stronger than average. When the current is given as weak, the speed is less than 0.1 knot. Observations of the current to a maximum depth of 20 feet were used in compiling these charts. The decimal point locates the position of the station.

The charts, which may be used for any year, are referred to the times of the slack water at The Race, which on the charts are designated "Slack; flood begins" and "Slack; ebb begins." Daily predictions for these times of slack water are included in the Tidal Current Table, Atlantic Coast of North America, published annually by the National Oceanic and Atmospheric Administration, National Ocean Survey.

Needell, S.W., C.J. O'Hara, and H.J. Knebel. 1983. Quaternary Geology of the Rhode Island Inner Shelf. Marine Geology. 53:41-53.

Neff, N.F. and R.S. Lewis. 1989. Non-energy Resources, Connecticut and Rhode Island Coastal Waters. Marine Geology. 90(1-2):125-130.

Abstract: Cores collected from Long Island Sound, Connecticut, were used to establish control on the geologic framework of the area. Lithologic and stratigraphic analyses verified the presence of the following units: (1) Cretaceous coastal plain, (2) Pleistocene glacial till, (3) late Pleistocene glacial lake, (4) late Pleistocene glacial outwash, and (5) Holocene fluvial, estuarine and marine deposits. Cores collected in Block Island Sound, Rhode Island, were obtained from inferred, relict shoreline features and were analyzed for heavy mineral content. During the second phase of the program of study, Connecticut and Rhode Island pooled resources to develop a study plan for the comprehensive quantification of all non-energy resources in the adjacent waters of the states. A literature and data survey was conducted to assess the occurrence, extent, and accessibility of these resources. Sand and gravel and heavy minerals were found in concentrations offering potential for resource exploitation. Constraints on exploitation include (1) water depth restrictions for the protection of shellfish beds and public beaches, (2) fishing activities, (3) military, commercial, and fishing vessel traffic, (4) seafloor cable routes and (5) dump sites. Additional aspects of the subject are discussed. (Edited author abstract) 12 Refs.

Newcombe, C.P. and O.T. Jensen. 1996. Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact. North American Journal of Fisheries Management. 16(4):693-727.

Nichols, J.A., G.T. Rowe, C.H. Clifford, and R.A. Young. 1978. In-situ Experiments on the Burial of Marine Invertebrates. Journal of Sedimentary Petrology. 48(2):419-426.

Abstract: The effect of burial on natural assemblages of benthic invertebrates was investigated using SCUBA techniques in Buzzards Bay, Massachusetts. Various thicknesses of sediment, free of macrofauna, were used to cover the bottom and its natural fauna within the constraints of small boxes and tubes. The taxa and number of organisms escaping this burial were determined by partitioning the containers into vertical sections. Most animals common to a soft-bottom community could escape a burial of 5 to 10 cm, but at depths of about 30 cm none even attempted to crawl up through the column of burying sediment. We suggest that "overburden stress," a measure which relates bulk density and burial depth, reaches a critically high value above which the animals cannot initiate an escape response.

Nixon, S.W. 1997. Prehistoric Nutrient Inputs and Productivity in Narragansett Bay. Estuaries. 20(2):253-261.

Abstract: Calculations by others of the preindustrial deposition of inorganic nitrogen from the atmosphere in the area of Narragansett Bay compared with recent measurements suggest that this flux has increased almost 15 times over natural background. On the basis of modern studies of the export of nitrogen and phosphorus from temperate forests, the prehistoric watershed also probably contributed very little reactive N or P to the bay. New information from undisturbed old-growth forests suggests that most of the N that was exported from the watershed was probably associated with refractory dissolved organic matter and thus contributed little to the fertility of the bay. The largest source of reactive dissolved inorganic nitrogen (DIN) and phosphorus (DIP) for Narragansett Bay under prehistoric conditions was the coastal ocean water entrained in the bay in estuarine circulation. The total input of DIN to this estuary has increased about five-fold and the input of total DIP has approximately doubled as a result of human activities. Recent ecosystem-level experiments using large (13 m^3, 5 m deep) mesocosms designed as living models of Narragansett Bay showed that the primary production of phytoplankton in the bay is limited by the supply of DIN and that annual phytoplankton production is strongly correlated with the rate of input of DIN. The relationship between DIN input and annual phytoplankton production in the mesocosms is consistent with observations published by others working in 10 different natural marine systems, and a functional production that would have been associated with the prehistoric DIN input estimates. The result of this calculation suggests that phytoplankton production in the bay has approximately doubled (from about 130 g C m^{-2} yr^{-1} to 290 g C m^{-2} yr^{-1} for a baywide average) since the time of European contact. It also seems likely that seagrasses and macroalgae once made a much larger contribution to total system production than they do today.

Nixon, S.W. and V. Lee. 1979. Spatial and Temporal Pollution Gradients in Narragansett Bay. International Council for the Exploration of the Sea, Water quality Committee.

Abstract: Large inputs of nitrogen and phosphorus as well as a variety of trace metals and petroleum hydrocarbons in urban and industrial sewage have produced river-sea concentration gradients for these materials in the sediments of Narragansett Bay, Rhode Island (USA). While the data are not available to prepare annual budgets for trace metals, it is clear that sewage also exceeds the input from all other sources combined. The large input of nitrogen and phosphorus in sewage may be responsible for the gradient in phytoplankton and zooplankton biomass that is found in the bay. Analysis of sediment cores for profiles of petroleum, metals and nutrients with depth have shown a long history of anthropogenic inputs dating back to the Industrial Revolution.

NOAA. 2000. Automated Wrecks and Obstructions Information System. 12 pp.

Abstract: This database is a listing by NOAA of all known wrecks and obstructions along the coast of the United States. This database can be searched by chart number, wreck number, or wreck name.

NOAA. 1979. Model-predicted Tidal Current Charts, Long Island Sound to Buzzards Bay. University of Rhode Island. Kingston, RI.

Abstract: Current charts of hourly direction and velocity of tidal currents in Long Island Sound, Block Island Sound, Rhode Island Sound and Buzzards Bay.

NOAA National Ocean Survey. 1973. Tidal Current Charts, Narragansett Bay to Nantucket Sound. 3rd Edition. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey. Rockville, Md.

O'Connor, T.P. 1990. Coastal Environmental Quality in the United States, 1990: Chemical Contamination in Sediment and Tissues. Coastal and Estuarine Assessment Branch, Ocean Assessments Division, Office of Oceanography and Marine Assessment, National Ocean Service, National Oceanic and Atmospheric Administration. Rockville, MD.

Abstract: This report, based on six years of results from the NS&T Program and other monitoring efforts, describes the spatial extent and severity of chemical contamination and changes in concentrations of contaminants over the last decade. While conclusions are always subject to new information, it appears that, on a national scale, high and biologically significant concentrations of contaminants measured in the NS&T Program are limited primarily to urbanized estuaries. In addition, levels of those contaminants have, in general, begun to decrease in the coastal U.S.

O'Connor, T.P. and B. Beliaeff. Recent Trends in Coastal Environmental Quality: Results from the Mussel Watch Project.

Abstract: The National Oceanic and Atmospheric Administration (NOAA) created the National Status and Trends (NS&T) Program in 1984 to address national concerns over the quality of the coastal marine environment. One of its goals is to assess spatial distributions and temporal trends in chemical contamination. To meet that goal, the NS&T Mussel Watch Project was formed in 1986 to measure concentration of a broad suite of trace metals and organic chemicals in surface sediments and whole soft-parts of mussels and oysters collected from about 300 coastal and estuarine sites. Here we summarize results from eight years of annually collecting and analyzing mollusks. The most important of these results indicates that contamination is decreasing for chemicals whose use has been banned, such as chlorinated hydrocarbons, or severely curtailed, such as cadmium. For other chemicals there is no evidence, on a national scale, for either an increasing or decreasing trend. There are some sites where trace element concentrations are both “high” and increasing.

O'Hara, C.J. 1980. High-resolution Seismic-reflection Profiling Data from the Inner Continental Shelf of Southeastern Massachusetts. USGS Open-file Report 80-178. U.S. Geological Survey. 2 pp.

Abstract: Six hundred-seventy kilometers of closely spaced high-resolution seismic-reflection data have been collected from eastern Rhode Island Sound and Vineyard Sound, Mass. (Fig 1). by the U.S. Geological Survey in cooperation with the Massachusetts Department of Public Works. These data were obtained during the June 1975 cruise of the R/V ASTERIAS as part of a continuing regional study of the Massachusetts offshore area to assess potential mineral resources, to evaluate environmental impact of mining of resources and of offshore disposal of solid waste and harbor dredge-spoil materials, and to map the offshore geology and shallow structure.

O'Hara, C.J. 1980. Side-scan Sonograph Data from Eastern Rhode Island Sound and Vineyard Sound, Massachusetts. USGS Open-file Report 80-283. U.S. Geological Survey. 3 pp.

Abstract: Two hundred twenty-four kilometers of closely spaced side-scan sonograph data have been collected from eastern Rhode Island Sound and Vineyard Sound, Mass. (Fig. 1), by the U.S. Geological Survey in cooperation with the New England Division of the U.S. Army Corps of Engineers. These data were obtained during the August 1976 cruise of the R/V A.E. VERRILL as part of a continuing regional study of the Massachusetts offshore area to determine the suitability and potential environmental effect of ocean dumping of large volumes of harbor dredge-spoil material.

Specifically, as part of a proposed Federal Harbor improvement and maintenance dredging of Fall River and Mr. Hope Bay, Mass. under jurisdiction of the Army Corps of Engineers, the disposal of the resultant dredge spoil is planned for an ocean dump site (shown in Fig. 1) located in eastern Rhode Island Sound. The proposed site is also under consideration as a "regional" disposal grounds to be utilized by State and private organizations performing dredging work authorized by the Corps.

The data were obtained by using a Klein Side Scan Towfish (sonar frequency, 100 kHz; pulse length, 0.1 msec). Signal returns from the starboard and port scans were automatically tuned, texture-enhanced, and printed center-out on 2 channels of a 3-channel Klein wet-paper graphic recorder. Scan ranges of 75 m and 150 m were used. For comparison of graphic display, incoming signals from the starboard scan were also recorded on the third channel using a manual (nonautomatic) tuning mode. Navigational control was provided by Loran C (positional accuracy within 0.2 km). Positional information was logged at 15-minute intervals and at major course changes.

The original records may be examined at the Data Library, U.S. Geological Survey, Woods Hole, MA 02543. Microfilm copies of the data are available for purchase from the National Geophysical and Solar-Terrestrial Data Center (NGSDC), Boulder, CO 80302

O'Hara, C.J. and R.N. Oldale. 1980. Geologic Hazards on the Inner Continental Shelf off Southeastern Massachusetts. Geological Society of America, Abstracts. 12(2):76.

O'Hara, C.J. and R.N. Oldale. 1980. Geology and Shallow Structure of Eastern Rhode Island Sound and Vineyard Sound, Massachusetts. Volume USGS Misc. Field Stud. Map MF1186. U.S. Geological Survey.

O'Hara, C.J. and R.N. Oldale. 1987. Maps Showing Geology, Shallow Structure, and Bedform Morphology of Nantucket Sound, Massachusetts. Page 4 sheets. Miscellaneous Field Studies Map - U. S. Geological Survey. U.S. Geological Survey. Reston, VA.

O'Hara, C.J. and R.N. Oldale. 1982. Marine Geologic Studies of the Inner Continental Shelf off Massachusetts. Pages 539-549 In: Farquhar, O.C., (Ed.), The Marine Boundary, Symposium on Geotechnology in Massachusetts. University of Massachusetts, Amherst, MA.

Abstract: Since 1972, the U.S. Geological Survey, in cooperation with the Massachusetts Department of Public Works, has been investigating the geology, structural framework, and resource potential of the Inner Continental Shelf off southeastern Massachusetts. Objectives of the marine cooperative include assessments of the Commonwealth's offshore mineral resources (principally sand and gravel) and the environmental impact of mining these deposits and of dumping solid-waste material to delineate areas that may be suitable for disposal of large volumes of harbor dredge-spoil material with minimum damage to the environment, and to identify potential geologic hazards that could impede or possibly preclude development of the Massachusetts coastal zone.

Field data consist mostly of closely spaced high-resolution seismic-reflection profiles and vibratory cores. More than 4800 km of seismic profiles and 100 vibracores have been obtained from Cape Cod Bay,

Buzzards Bay, Vineyard Sound, eastern Rhode Island Sound, Nantucket Sound, Massachusetts Bay, and waters off Cape Ann. Major products of our research include maps of the offshore geology and shallow structure and reports describing the geologic history of this part of the Atlantic Inner Continental Shelf. We have constructed isopach maps of significant geologic units, structure-contour maps of major contacts or unconformities, and geological and hazards maps of the sea floor, all of which will be useful in the economic evaluation and future utilization of the state's coastal resources.

Oldale, R.N. 1969. Seismic Investigations on Cape Cod, Martha's Vineyard and Nantucket, Massachusetts, and a Topographic Map of the Basement Surface from Cape Cod Bay to the Islands. U.S. Geological Survey. 650B:B122-B127.

Oliveira, K. 1999. Life History Characteristics and Strategies of the American Eel, *Anguilla rostrata*. Canadian Journal of Fisheries and Aquatic Sciences. 56(5):795-802.

Abstract: Several life history hypotheses for the American eel, *Anguilla rostrata*, were examined using seaward-migrating silver-phase eels collected in the Annaquatucket River, Rhode Island, U.S.A. Female eels were significantly larger and older than males. Female eels also had a significantly higher mean growth rate. The addition of life history data from Annaquatucket River eels to published silver eel data from locations throughout the eels' range show that female size at migration is positively correlated with latitude ($r = 0.56$, $p = 0.05$) but male size is not ($r = 0.54$, $p = 0.17$). Female age was not related to latitude ($r = 0.57$, $p = 0.27$) but male age showed a positive relationship ($r = 0.87$, $p = 0.05$). Growth rates for females and males were inversely related to latitude ($r = –0.98$, $p = 0.02$ and $r = –0.95$, $p = 0.05$, respectively). Differences between the latitudinal relationships and life history traits of the sexes may be due to differences in life history strategies.

Oliveira, K. 1997. Movements and Growth Rates of Yellow-phase American Eels in the Annaquatucket River, Rhode Island. Transactions of the American Fisheries Society. 126(4):638-646.

Abstract: Eight hundred twenty nine yellow-phase American eels Anguilla rostrata, 160-740 mm total length (TL), were electrofished from 10 stations in the Annaquatucket River, Rhode Island. The eels were individually marked with liquid-nitrogen-cooled brands and released at the site of collection. Resampling yielded 200 recaptures (24%); eels were recaptured at 8 of the 10 stations after 1 year. Of all recaptures, 174 (87%) were from the station of release, indicating restricted movement by American eels from the collection sites. Stations associated with dams had higher recapture rates, but there was no significant relationship between percent recaptured and eel density, station size, or distance upriver. An annual growth rate (mean +- SE) of 29.9 +- 4.7 mm/year for all American eels was estimated for a 214-d growing season. The growth rate for eels longer than 399 mm TL, which have previously been shown to be female, was 62.10 +- 14.9 mm/year, 2.3 times greater than for eels less than 400 mm. Mean growth rates do not appear to be a function of distance upriver or density but are more closely related to the sex ratio of eels at the station. Comparison of these growth rates with other published growth rates suggests that both sex ratio and latitude are important factors influencing the growth rate of a given population.

Onbé, T. 1991. Some Aspects of the Biology of Resting Eggs of Marine Cladocerans. Crustacean Egg Production. 7:41-56.

Abstract: Resting eggs are described and illustrated for 6 marine species: *Penila avirostris, Evadne nordmanni, E. tergestina, Podon intermedius, P. leuckarti* and *P. polyphemoides* . Development and hatching processes of eggs are described for *P. avirostris, E. tergestina* and *P. polyphemoides*. Distribution and abundance of resting eggs in sediments have been studied in southern Japan, in particular, in the Inland Sea of Japan; Buzzards Bay, Massachusetts, USA; and the Gulf of Marconi, northern Ligurian Sea, Italy. In the majority of cases, the eggs of *Penilia* avirostris were most abundant. Evidence indicates that organic sediment pollution reduces the survival of benthic resting eggs. Adaptive significance of resting eggs is discussed in view of the life history patterns of marine cladocerans.

Orciari, R.D. and G.H. Leonard. 1996. Length Characteristics of Smolts and Timing of Downstream Migration among Three Strains of Atlantic Salmon in a Southern New England Stream. North American Journal of Fisheries Management. 16(4):851-860.

Abstract: As part of a program to restore Atlantic salmon *Salmo salar* to the Connecticut River system, 10 year-classes of fry were stocked to produce smolts in Sandy Brook, Connecticut. During 1980-1986, fry were obtained from sources outside of the Connecticut River system; a geographically distant stain from Iceland was stocked in three of the years (1980, 1981, 1983), and the Penobscot strain, which originated from several rivers in Maine, was stocked in four of the years (1982, 1984, 1985, 1986). As restoration efforts continued, fry originating from adults that had returned to the Connecticut River were stocked in the final three years (1988, 1989, 1991). Although all strains produced a predominance of age-1 and age-2 smolts, length characteristics of smolts differed among strains. Total lengths of Icelandic smolts averaged 9-11 mm smaller at emigration at age 1 and 13-21 mm smaller at emigration at age 2 than both New England strains. Based upon minimum lengths that 95% of all smolts attained the previous growing season, most Icelandic parr smolted if they reached 87 mm at the end of their first growing season or 130 mm at the end of their second growing season. In contrast, most New England smolts had attained total lengths of 113 mm and 147 mm by the end of their first and second growing seasons, respectively. Icelandic age-1 smolts also migrated up to 2 weeks later and at mean water temperatures 3 degree C higher than New England age-1 smolts. The late migration of small Icelandic smolts may not be appropriate for successful emigration from southern New England streams.

Orciari, R.D., G.H. Leonard, D.J. Mysling, and E.C. Schluntz. 1994. Survival, Growth, and Smolt Production of Atlantic Salmon Stocked as Fry in a Southern New England Stream. North American Journal of Fisheries Management. 14(3):588-606.

Abstract: The performance of Atlantic salmon *Salmo salar* stocked as fry was assessed in a third-order stream of the lower Connecticut River system. Stocking densities of 100-150 unfed fry per 100 m² of stream area were tested for their ability to maximize smolt production. Because the Connecticut River no longer had a natural population of Atlantic salmon, fry originating from the Penobscot River of Maine were stocked in 1982, 1984, and 1985. In 1983, the Penobscot strain was unavailable and fry originating from Iceland were used instead. Although stocking conditions were not always favorable, an average of 27% of Penobscot fry survived to the fall age-0 parr stage. In contrast, only 2% of Icelandic fry survived to this stage. The low survival of Icelandic fry may have been due to their smaller total lengths and to intraspecific competition from an abundant population of yearlings that had been stocked in 1982. However, these factors would not have influenced summer-to-fall survival of yearlings, which was also lower for Icelandic fish (41%) than for Penobscot fish (59-62%). The lower survival of Icelandic parr suggests that this geographically distant strain may not be suited for fry stocking in southern New England. The more regional Penobscot strain performed very well; on average, stocking 125 fry/100 m² yielded 34 fall age-0 parr, 10 fall age-1 parr, and 3.6 smolts (87% age 2) per 100 m² . By the end of the growing seasons, Penobscot fry that were stocked at an average total length of 29 mm averaged 89 mm at age 0, 150 mm at age 1, and 178 mm at age 2. As smolts, they averaged 158 mm at age 1, 186 mm at age 2, and 202 mm at age 3. Because our limited data suggested density-dependent effects on growth and survival, the high production of smolts may have been at the expense of fry-to-smolt survival. Stocking at high densities may not be appropriate when survival rates of limited numbers of fry are to be optimized. But when the management objective is to produce Atlantic salmon smolts at near-maximum levels in southern New England streams, stocking fry at densities of 100-125/100 m² should produce 3-4 Atlantic salmon smolts per 100 m² of total stream area.

Osman, R.W. and R.B. Whitlatch. 1998. Local Control of Recruitment in an Epifaunal Community and the Consequences to Colonization Processes. Hydrobiologia. 375/376:113-123.

Abstract: We found that recruitment, abundance, and dominance within two subtidal epifaunal communities in southern New England, USA persist year after year over large areas of the bottom. This long-term persistence in both dominance and recruitment is not expected in such an open system with disturbances continually creating open patches for recruiting larvae whose identity and abundances change

both temporally and spatially. We suggest that the persistence results from strong local control of recruitment that overrides any variability in larval production and dispersal of species from outside a site. Although local dynamics that control persistence involve all life-stages, we found that intense predation on post-settlement individuals has drastic effects. This predation alters the relative abundances of recruits, prevents the invasion of some species, and allows others to dominate. In addition, epifaunal communities are often dominated by species producing short-lived, poorly dispersed larvae. The continued local recruitment of these species at a given site can contribute to the long-term persistence of dominants already present. Based on these observations, we suggest that a system of locally reproducing, self-sustaining populations coupled with strong local environmental differences (*e.g.* predation on recruits) limiting the invasion of other species may better represent some subtidal benthic communities than a system with widely-dispersed larvae, recruitment dominated by production outside the community, disturbance creating continual changes in dominance, and little long-term persistence.

Osman, R.W. and R.B. Whitlatch. 1995. Local Dispersal and the Long-term Persistence of Benthic Communities. Grassle, J.P., A. Kelsey, E. Oates, and P.V. Snelgrove. (Eds.), Twenty-Third Benthic Ecology Meeting. New Brunswick, NJ, March 17, 1995-March 19, 1995. Various pages.

Abstract: Our research has found long-term persistence of species abundance patterns within two shallow-water communities of southern New England. These communities are dominated by species producing short-lived and thus poorly dispersed larvae. The long-term persistence appears to be a consequence of continued local recruitment of these species, coupled with intense post-settlement predation, which reduces or eliminates the ability of other species to successfully establish themselves in the communities. Based on these observations, we suggest that in contrast to rocky intertidal species assemblages, subtidal benthic communities are much less influenced by temporal differences in settlement and recruitment. Local control of dispersal may result in persistent dominance patterns over broad spatial and temporal scales.

Overholtz, W.J., R.S. Armstrong, D.G. Mountain, and M. Tercerio. 1991. Factors Influencing Spring Distribution, Availability, and Recreational Catch of Atlantic Mackerel (*Scomber scombrus*) in the Middle Atlantic and Southern New England Regions. NOAA Tech. Memo TM F/NEC-85. Page 19 pp.

Abstract: The relationship between the spring distribution of Atlantic mackerel (Scomber scombrus), environmental factors, and the recreational fishery for mackerel in the mid-Atlantic-southern New England region was investigated. The Northwest Atlantic stock of Atlantic mackerel is highly migratory, with the southern spawning contingent showing a pronounced inshore and northward migration during the spring and early summer, and the northern spawning contingent moving north into the Gulf of St. Lawrence at this time. Examined were catch distribution maps constructed from spring research vessel bottom trawl surveys; results indicated that the center of abundance of the stock shifts toward the south in years with cool-to-moderate shelf temperatures and shifts northward in warmer years. Catches of mackerel in the Northeast Fisheries Science Center's spring bottom trawl surveys are usually at bottom water temperatures of 5 °C or greater, mackerel tend to actively avoid cooler water. Recreational catch in the Mid-Atlantic - Southern New England region is positively, but weakly, correlated with stocksize, and is probably highly influenced by the thermal regime in the early spring. See also PB89-151948 and PB90-252172.

Oviatt, C.A. et al. 1984. Recovery of Polluted Estuarine System: A Mesocosm Experiment. Marine Ecology Progress Series 16: 203-217.

Oviatt, C.A. and S.W. Nixon. 1973. The Demersal Fish of Narragansett Bay: An Analysis of Community Structure, Distribution and Abundance. Estuarine and Coastal Marine Science. 1:361-378.

Oviatt, C.A. and S.W. Nixon. 1975. Sediment Resuspension and Deposition in Narragansett Bay. Pages 201-17. Volume 3. University of Rhode Island, Sea Grant Marine Advisory Service. Narragansett, RI .

Abstract: Monthly samples of sediments deposited in traps at three locations in Narragansett Bay, Rhode Island, showed a gradient in sediment activity that increased from an annual mean of $\pm 8 \cdot 8 gm^{-2}$ day ^{1} at the

head of the estuary to 51 ± 16·7 gm^{-2} day^{1} at the mouth. Deposited materials were significantly higher in total organic matter, organic carbon and nitrogen than near surface sediments on the bottom. These parameters showed a gradient that decreased toward the mouth of the bay, with organic matter dropping from 14± 1 to 10±% of the dry weight deposited; carbon from 5·4 ± 0·9 to 3·4 ± 1·0; and nitrogen from 0·6 ± 0·1 to 0·4 ± 0·1%. The annual mean C/N ratio was 8·2 in the lower bay and 8·7 in the upper bay. Deposited materials were dominated by particles in the silt size range from 4-60 µm and comprised for the most part resuspended bottom sediments rather than fresh inputs of material from the water column.

Palma, A.T., R.S. Steneck, and C.J. Wilson. 1999. Settlement-driven, Multiscale Demographic Patterns of Large Benthic Decapods in the Gulf of Maine. Journal of Experimental Marine Biology and Ecology. 241(1):107-136.

Abstract: Three decapod species in the Gulf of Maine (American lobster Homarus americanus Milne Edwards, 1837, rock crab Cancer irroratus Say, 1817, and Jonah crab Cancer borealis Stimpson, 1859) were investigated to determine how their patterns of settlement and post-settlement abundance varied at different spatial and temporal scales. Spatial scales ranged from centimeters to hundreds of kilometers. Abundances of newly settled and older (sum of several cohorts) individuals were measured at different substrata, depths, sites within and among widely spaced regions, and along estuarine gradients. Temporal scales ranged from weekly censuses of new settlers within a season to inter-annual comparisons of settlement strengths. Over the scales considered here, only lobsters and rock crabs were consistently abundant in their early post-settlement stages. Compared to rock crabs, lobsters settled at lower densities but in specific habitats and over a narrower range of conditions. The abundance and distribution of older individuals of both species were, however, similar at all scales. This is consistent with previous observations that, by virtue of high fecundity, rock crabs have high rates of settlement, but do not discriminate among habitats, and suffer high levels of post-settlement mortality relative to lobsters. At settlement, large, habitat-scale differences exist for lobsters but not for rock crabs; these are probably the result of larval settling behavior. In contrast, patterns at the largest, inter-regional, spatial scales suggest oceanographic control of larval delivery. Increased mobility and vagility with greater body size for both species reduces demographic differences among older individuals over a range of spatial scales.

Parker, R.H., J.S. Nagle, A.B. Williams, and R. Kaufman. 1965. Seasonal Aspects of Hadley Harbor Benthic Ecology. Biological Bulletin. 129:418.

Abstract: Animal populations in Hadley Harbor benthic communities vary seasonally in numbers and dispersion. Populations of infaunal amphipods and mollusks increase markedly immediately after their breeding periods, decreasing to a minimum by the next breeding season. Coexistent and predominant infaunal animals have breeding cycles which are staggered, perhaps to avoid competition in larval settlement. However, infaunal animals exhibit constant annual dispersion, occurring in the same areas and at the same stations in summer and winter.

Mollusks epifaunal on eelgrass show a summer maximum coincident with breeding periods, but also have high fall and winter maxima, unrelated to breeding. Eel-grass-dwelling amphipods not only exhibit the concentrated winter maxima of mollusks, but also have several submaxima throughout the year. These submaxima are related to the staggered breeding cycles of potentially competing species which breed throughout the year.

Eelgrass epifauna are more concentrated at certain stations in the winter where the eelgrass survives the winter kill. Since these organisms shift their population centers to areas of high winter eel grass cover, and many species virtually disappear from areas where the eelgrass dies down, it appears that a migration takes place. Moreover, some eelgrass forms, such as the

amphipod, *Microdeutopus damnoniensis*, seem to be excluded from the shallow eelgrass flats by high summer temperatures. With the reoccurrence of cooler fall temperatures these forms reappear in the shallow areas.

A relatively stable summer thermocline develops in the inner harbor, resulting in a reduction in oxygen below the thermocline, and ultimately the development of reducing conditions on the surface of the bottom. During this time the motile infauna, such as the pelecypods, *Yoldia limatula* and *Macoma tenta*, disappear from the area, migrating to more favorable oxygenated locations.

Paton, D. 1988. Gray Seal Pups Establish Critical Marine Habitat in Nantucket Sound, U.S.A. Biological Bulletin. 175:312.

Abstract: Halichoerus grypus birthings at Muskeget Island, Nantucket Sound, during the winter of 1987/1988 occurred during the last week of January. Surveys of the Nantucket and Martha's Vineyard sounds, the Elisabeth Islands, and Nomans Island were begun in early November. Solitary males were seen at the North Shore of Muskeget in early December. Aerial reconnaissance at elevations of 240 and 1000 meters were made with the Hasselblad 250 and 80 mm Zeiss lenses and Kodochrome ASA 64 film. The photographic transparencies were magnified and enhanced with digital techniques and flat plane microscopic objectives. There is irrefutable evidence in these recent surveys that the life history of a pod of gray seals is begun here. The habitat includes pupping grounds, fishing, and molting haulouts.

Patton, K.T. 1969. Prediction of Wind Waves in Block Island Sound. USL Technical Memorandum No. 2212-78-69. U.S. Navy Underwater Sound Laboratory. New London, CT.

Abstract: Future acoustic, oceanographic and ocean engineering programs to be conducted by the Ocean Sciences Division in Block Island Sound will involve the prediction of sea state or the correlation of acoustic or oceanographic data with sea conditions. In lieu of in-situ wave measurements, the prediction of wind waves computed from observed wind speeds, directions and durations may serve for some of these programs. The model presented in this memorandum has been developed for the BIFI acoustic ranges; however, the equations can be applied to any body of water.

Payne, P.M., D.N. Wiley, S.B. Young, S. Pittman, P.J. Clapham, and J.W. Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fishery Bulletin. 88(4):687-696.

Abstract: Significant changes in the biomass of sandlance *Ammodytes* spp. and in the abundance of the copepod *Calanus finmarchicus* in the southern Gulf of Maine co-occurred with a shift in the occurrence and abundance of four species of baleen whales in the region. During the years 1982–88 the abundance of sandlance was negatively correlated to the abundance for *C. finmarchicus* (r_s= –0.883, P<0.05). Peak years of abundance for *C. finmarchicus* during 1982–88 in the study area were the lowest years of abundance for sandlance. The abundance of *C. finmarchicus* and sandlance was at a regional maximum during 1986 and 1988, respectively.

The abundance of humpback and fin whales were marginally correlated to each other (r_s= 0.3338, P<0.08). The abundance of humpbacks was negatively correlated with right whales (r_s= –0.7753, P<0.001) and sei whales (r_s= –0.5507, P<0.01). The patterns of occurrence for right and sei whales were significantly related to each other (r_s= 0.6842, P<0.001). Right and sei whales were common in the region only during 1986, when copepod abundance reached a regional maximum and sandlance abundance a regional minimum. These patterns of whale occurrence reflect known prey preferences, and are therefore expected between the pisciverous humpback and fin whales and the highly planktiverous right and sei whales.

We hypothesize that the spatial distribution and abundance of baleen whales in the Gulf of Maine can be characterized as a series of ecological responses to human-induced changes in the abundance of planktiverous finfish.

Pearcy, W.G. 1962. Ecology of an Estuarine Population of Winter Flounder, *Pseudopleuronectes americanus* (Walbaum). Parts I-IV. Bulletin of the Bingham Oceanographic Collection. 18(1):6-78.

Abstract: The Mystic River estuary, in eastern Connecticut, is small, only 8.5 km in length, and its tidal prisms is 38% of the volume at mean high water (11.4 x 10 m3). The recorded temperature in the channel during 1958-1959 ranged from 0.8 to 25°C, with seasonal warming and cooling taking place more rapidly in the upper than in the lower estuary. Salinity at the mouth averaged 30 o/oo and decreased toward the head. Vertical salinity stratification became more pronounced landward, indicating a well developed two-layer transport system in the upper estuary. Current profiles also displayed vertical differences that reflected two-layer transport. The exchange ratio for the upper estuary during the spring, calculated from net current velocities, volume of freshwater influent, and morphometric measurements, is estimated to be 0.16.

Pennington, M. and O.R. Godø. 1995. Measuring the Effect of Changes in Catchability on the Variance of Marine Survey Abundance Indices. Fisheries Research (Amsterdam). 23(3-4):301-310.

Abstract: The average catch per tow by a research vessel survey is often used as an index of abundance. An estimate of the variance of such indices that is based only on the between station variability in catch may underestimate the true variance if catchability varies over time. In this paper, the survey index variance is estimated indirectly by cross-calibrating time series of virtual population analysis estimates and trawl survey indices of abundance. The method is applied to surveys of some fish stocks on Georges Bank, in southern New England, and in the Barents Sea. For these surveys, it appears that the true variance of the survey indices is approximately twice as large as the usual estimates based on the within survey variance. As an application, a time series technique, which requires an estimate of the survey index variance, is used to generate a more precise index of abundance. The results indicate that for the surveys examined the variance of the estimated abundance index is 30-40% smaller than the original (average catch per tow) index.

Pereira, J.J., R. Goldberg, J.J. Ziskowski, P.L. Berrien, W.W. Morse, and Johnson. D.L. 1999. Essential Fish Habitat Source Document: Winter Flounder, *Pseudopleuronectes americanus*, Life History and Habitat Characteristics. NMFS Tech. Memo (In Press). 39 pp.

Abstract: This Essential Fish Habitat source document will focus on specific habitat requirements of the various life history stages of winter flounder as well as their historical and current geographical distributions.

Peterson, S. and L. Smith. 1981. Small-scale Commercial Fishing in Southern New England. Woods Hole Oceanographic Institute Technical Report. WHOI-81-72. NOAA Sea Grant 04-8-M01-149.

Petti, M.J. 1975. Phosphorus Exchange at the Sediment-Water Interface of Selected Narragansett Bay Sediments.

Abstract: Narragansett Bay sediments were sampled in the vicinities of Whale Rock, Prudence Island, and Field's Point. The sediments were used in a microcosm study to determine the release and uptake of nutrients from the sediments to the water column above. The nutrient investigated is phosphorus.

It was found that sediments can act as a source or sink of phosphorus to the water column above and affect the productivity of these waters. The release or uptake of phosphorus is a function of complex biological, chemical and physical factors, which have been enumerated and described as a function of an exponential rate expression.

Aerobic and anaerobic conditions are tested. It was found that when the concentration gradient of phosphorus with respect to water and sediments is in the direction of sediments to water, anaerobic conditions caused more release than aerobic. When the gradient is in the direction of water to sediments, aerobic conditions realized more uptake of phosphorus than anaerobic.

Pierce, D.E. and A.B. Howe. 1977. A Further Study on Winter Flounder Group Identification off Massachusetts. Transactions of the American Fisheries Society. 106(2):131-139.

Abstract: Dorsal and anal fin ray number variation was studied in 5,322 young-of-the-year winter flounder, Pseudopleuronectes americanus (Walbaum), collected from the Cape Cod region during 1969-71. Data were analyzed by Duncan's multiple range tests, analysis of variance, and *t*-tests. Flounder from separate estuaries did not constitute individual groups. The existence of a north-of-Cape Cod group and a south-of-Cape Cod group was confirmed; a Martha's Vineyard group was identified.

Pierce, D.R. 1981. Scup, *Stenotomus chrysops* (L)., of Southeastern Massachusetts Waters - Growth and Yield, Fisheries, and Management. M.S. Thesis. Southeastern Massachusetts University. North Dartmouth, MA. 173 pp.

Pilson, M.E.Q. 1985. Annual Cycles of Nutrients and Chlorophyll in Narragansett Bay, Rhode Island. Journal of Marine Research. 43:849-873.

Abstract: Nutrient concentrations in Narragansett Bay change in a regular way through the seasons, so that characteristic and well defined cycles are observed, but are different for each nutrient. The cyclic changes are not explainable by processes in the water column alone, nor by advection, even though the replacement time of water in the bay is only 10-40 days. It appears possible to incorporate much of the cycling activity in 13-m^3 microcosms, so these must include the dominating features of the complex biogeochemical processes involved. Observations in the microcosms suggest that the processes maintaining the annual cycles are sufficiently strong that, in the absence of deliberate experimental manipulation, the cycles might continue not significantly altered through at least one year. Therefore, the nutrient cycles in the bay can be driven largely by activities internal to the bay, especially sediment-water exchanges.

Pilson, M.E.Q. 1985. On the Residence Time of Water in Narragansett Bay. Estuaries. 8(1):2-14.

Abstract: For Narragansett Bay, Rhode Island, newly calculated and archival data for the area, mean depth, total volume, mean salinity and fresh water input are presented. Estimates of the residence time of the water, derived from 22 sets of monthly mean values, were related to estimates of the fresh water input according to the empirical relationship $T=41.8\ e^{-0.00435(FW)}$, where T is the flushing time in days, and FW is the fresh water input in m^3 per s; the r^2 value is 0.841. Adding estimates of the mean wind speed into a multiple regression increased the correlation coefficient only to 0.864. At the long-term mean rate of fresh water input (105 m^3 per s) the flushing time is 26 days. At the lowest mean monthly input rate observed the flushing time was nearly 40 days, while at the highest mean monthly input rate in the data set (325 m^3 per s) the flushing time was about 10 days. Known sources of random error appear sufficient to account for most of the deviations from the relationship. The evidence suggests that variation in the flushing time is largely determined by variation in the fresh water input.

Pilson, M.E.Q. and C.D. Hunt. 1989. Water Quality Survey of Narragansett Bay, A Summary of Results from SINBADD 1985-1986. Report #NBP-89-22. Rhode Island Department of Environmental Management. Providence, RI.

Abstract: The results are presented from four cruises to sample Narragansett Bay for concentrations of nutrients and trace metals. The objectives of the study were (a) to obtain a view of the whole of Narragansett Bay with respect to the concentrations of nutrients and trace metals, during each time of sampling; (b) to obtain estimates of the inputs of these substances into the bay during the times of the

surveys; and (c) to collect these data with associated parameters in such a way as to be of most use to subsequent modeling efforts and to provide a point of reference so that future changes in the chemistry of the bay can be evaluated.

Pogue, P. and V. Lee. 1993. Public Access to the Rhode Island Coast : A Selective Guide to Parks, Wildlife Refuges, Beaches, Fishing Sites, Boat Ramps, Pathways, and Views along Rhode Island's Coast. University of Rhode Island, Division of University Relations.

Abstract: Rhode Island is richly endowed with a magnificent shoreline. Access to this shore is an essential part of the heritage of the people of the Ocean State. As a consequence of a long tradition of a variety of commercial uses of the shore, combined with forward-looking government policy to purchase coastal open space for public use, Rhode Island has a multitude of coastal access areas. This is a guide to 329 popular public access sites chosen from the many hundreds that exist. It is a guide to the variety of different kinds of access and recreational opportunities they provide: whether you wish to launch a boat on the Bay, swim at the ocean beaches, party or picnic at coastal parks, photograph ducks during fall migration, or seek solace and solitude along the shore.

Pollnac, R.B. 1976. Continuity and Change in Marine Fishing Communities. International Center for Marine Resource Development, University of Rhode Island. Kingston, RI.

Abstract: This paper is on the sociocultural antecedents and consequences of the diffusion of innovations and the innovative Process for a number of years. This paper has nothing to do with the environment.

Poppe, L.J., J.A. Commeau, and P.C. Valentine. 1991. Mineralogy of the silt fraction in surficial sediments from the outer continental shelf off southeastern New England. Journal of Sedimentary Petrology. 61(1):54-64.

Abstract: Mineralogical studies of the silt fraction have been made on surficial sediments from the U.S. North Atlantic outer continental shelf off southeastern New England. The silt-sized heavy mineral assemblage, which is predominantly detrital, has been concentrated in this fraction by hydraulic factors and ranges between 11.8 wt. % of the silt fraction in the sandy sediments near Georges Bank to 3.4% in the clayey silt deposit south of Martha's Vineyard. By contrast, the sand fraction averages only 1.5% heavy minerals. Corundum and the rutile + leucoxene + brookite + anatase, epidote, and apatite + monazite + vivianite groups are relatively enriched in the silt fraction, whereas the amphibole and garnet + staurolite groups are relatively concentrated in the sand fraction. “Opaque” minerals average 27.8% ilmenite, 4.8% magnetite + hematite + goethite + siderite, 1.6% ferromanganese-coated grains, and 0.9% pyrite of the silt-sized heavy mineral fraction.

Lateral variability within the silt-sized heavy mineral assemblage is considerable. Zircon and ilmenite abundances progressively decrease from east to west on the continental shelf off southeastern New England. Conversely, abundances within the amphibole and the epidote groups increase from east to west. Quartz dominates the light mineral + layered silicate fraction, where it averages 70.3%. The K-feldspar/plagioclase ratios and glauconite + mica/chlorite ratios average 0.38 and 2.61, respectively. The layered silicates are concentrated in the finer-grained sediments. Although the heavy mineral assemblage is ultimately a function of provenance, the spatial trends observed in the heavy mineral populations are due primarily to sorting that is associated with westwardly-flowing bottom currents and are related to the specific gravity and the characteristic size of the mineral grains.

Elevated concentrations of titanium in the silty sands south of Nantucket Shoals are related to the abundances of ilmenite, sphene, and the TiO_2 group minerals and average 0.67 wt. % of the bulk sediment. This deposit may constitute an exploitable resource.

Porter, E.T., R.I.E. Newell, and L.P. Sanford. 1996. Physical and Biological Scaling of Benthic-pelagic Coupling in Coastal Ecosystems: The Role of Bivalve Suspension Feeders. Journal of Shellfish Research. 15(2):490-491.

Abstract: It is increasingly recognized that benthic suspension-feeding bivalves are an important component of estuarine ecosystems because they increase the transfer of seston and particle-bound toxicants from the water column to the benthos and because of their role in nutrient regeneration. Water flow is crucially important for supplying seston to the bivalves and controlling benthic-pelagic nutrient fluxes at the sediment-water interface. Previous studies on seston removal by bivalves and nutrient regeneration have been performed either in flumes in the laboratory or field flumes, and in laboratory mesocosms such as the Marine Ecosystems Research Laboratory at the University of Rhode Island. A disadvantage of flumes is that water column processes are not adequately scaled although benthic boundary-layer processes are well represented. Mesocosm water column processes may be represented well but processes at the sediment-water interface are not accurately scaled. Minimal mixing at the sediment-water interface in mesocosm tanks is problematic for accurately studying benthic processes because low water flow directly affects seston uptake by bivalves and may lead to refiltration, enhanced sedimentation, reduced resuspension, and a change in nutrient regeneration processes. Therefore, results from such studies in flumes or mesocosms cannot be scaled up to ecosystem level with confidence. We utilized coupled mesocosm and flume systems to study nutrient and particle fluxes at the benthic boundary layer in order to obtain benefits inherent in both experimental systems. We studied the effect of the interaction of benthic bivalve suspension feeders and water flow on seston quantity and quality and on nutrient regeneration in systems of two different sizes and with different water flows at the sediment-water interface. Preliminary results of replicate experiments indicate the oysters (Crassostrea virginica) decrease Chl a and seston concentrations in systems of both sizes, but water flow did not appear to have a substantial effect. However, water flow at the sediment-water interface did significantly affect nutrient regeneration in systems with bivalves and in systems of both sizes. These results emphasize the importance of considering water flow in ecosystem studies with benthic bivalve suspension feeders.

Powell, J. C. 2000. Assessment of recreationally important finfish stocks in Rhode Island Waters. Narragansett Bay juvenile finfish survey. Segment number 8. Project Number F-61-R. 14 pp.

Abstract: Eighteen fixed stations around Narragansett Bay were sampled once a month from June through October 2000 with the standard 60 × 3.05 m beach seine. Adults and juveniles of 42 species representing 30 families were collected. All individuals of the target species: winter flounder, tautog, bluefish, squeteague, scup and members of the herring family (Clupeidae) were enumerated and measured. Presence and relative abundance of three forage species: Atlantic silversides, common mummichog and striped killifish were noted. Data on weather, water temperature, salinity and dissolved oxygen were recorded at each station.

Powell, J. C. 2001. Assessment of recreationally important finfish stocks in Rhode Island Waters. Narragansett Bay juvenile finfish survey. Segment number 9. Project Number F-61-R. 14 pp.

Abstract: Eighteen fixed stations around Narragansett Bay were sampled once a month from June through October 2001 with the standard 60 × 3.05 m beach seine. Adults and juveniles of forty species representing twenty-nine families were collected. All individuals of the target species: winter flounder, tautog, bluefish, squeteague, scup and members of the herring family (Clupeidae) were enumerated and measured. Presence and relative abundance of three forage species: Atlantic silversides, common mummichog and striped killifish were noted. Data on weather, water temperature, salinity and dissolved oxygen were recorded at each station.

Powell, J. C. 1999. Assessment of recreationally important finfish stocks in Rhode Island Waters. Narragansett Bay juvenile finfish survey. Segment number 7. Project Number F-61-R. 14 pp.

Abstract: Eighteen fixed stations around Narragansett Bay were sampled once a month from June through October 1999 with the standard 60 × 3.05 m beach seine. Adults and juveniles of 42 species representing 27 families were collected. All individuals of the target species: winter flounder, tautog, bluefish,

squeteague, scup and members of the herring family (Clupeidae) were enumerated and measured. Presence and relative abundance of three forage species: Atlantic silversides, common mummichog and striped killifish were noted. Data on weather, water temperature, salinity and dissolved oxygen were recorded at each station.

Powell, J.C. 1986. Juvenile Marine Finfish Survey, 1986. Performance Report. Project No. F-26-R-21. Rhode Island Division of Fish and Wildlife. 21 pp.

Powell, J.C. 1995. Juvenile Marine Finfish Survey, 1995. Performance Report. Project No. F-61-R-3. Rhode Island Division of Fish and Wildlife. 38 pp.

Powell, J.C. 1997. Juvenile Marine Finfish Survey at Greene Island, July 21, 1997. Rhode Island Division of Fish and Wildlife.

Powell, J.C. 1996. Juvenile Marine Finfish Surveys, 1987-1996: Annual and Long term (1987-1996) Mean Abundance (Catch/Seine) of Winter Flounder and Tautog Juveniles for all Months (June-October) at each Station. Rhode Island Division of Fish and Wildlife.

Powell, J.C. 1991. Winter Flounder Population Assessment. Performance Report. F-26-R-26. Rhode Island Division of Fish and Wildlife. 16 pp.

Powell, J.C. 1989. Winter Flounder Spawning Characteristics and Habitat Requirements. Volume Research Reference Document 89/4. Rhode Island Division of Fish and Wildlife. 16 pp.

Abstract: The purpose of this paper is to describe what is known about spawning characteristics and habitat requirements of each winter flounder life history stage. Information presented in this report is from two sources: the literature and data gathered during various studies conducted by the R.I. Division of Fish and Wildlife on Rhode Island winter flounder populations.

Powell, J.C. 1989. Winter Flounder Tagging Study, 1986-1988, with Comments on Movement . Research Reference Document 89/3. Rhode Island Division of Fish and Wildlife. 19 pp.

Abstract: During the winter of 1985-86 the (Rhode Island) Division (of Fish and Wildlife) began a long term tagging study of Narragansett Bay winter flounder populations. Our goal was to tag 9000 legal size winter flounder on the upper Bay spawning grounds during the first three years of the study. Tagging was limited to legal size (280mm or 11") and larger individuals. Tagging studies on the Mt. Hope Bay and Sakonnet River populations will follow in subsequent years.

The purpose of this report is to describe the tagging study and specifically what has been learned regarding seasonal movement of winter flounder in Narragansett Bay and adjacent offshore waters over the past three years. Historical tagging studies are also reviewed. Similarities between these studies and the present study are discussed.

Powers, C.F. 1953. Circulation in the Newport Bight - Block Island Sound - New York Bight Area. Status Report No. 25, Contract N6 onr 264, Task 15 NR #083-033. Cornell University.

Abstract: During the summer of 1951 a hydrographic survey was made of the waters between Martha's Vineyard and Barnegat Inlet, New Jersey; the survey extended seaward to the twenty-five fathom curve. The surveyed waters included those of Newport Bight, Block Island Sound, and New York Bight. The offshore waters of the area are a part of the southwest Coastal Drift, which has been shown previously to extend southward to the region of Cape Hatteras (Powers and Ayers, 1951). The inshore waters of the area receive the discharge from a number of rivers, including those draining into Long Island Sound. The fresh water entering from the rivers is carried away by a complex circulation. Much of the area is estuarine in

nature, but due to its "open sea" situation its hydrography cannot be analyzed by the methods usually applied to estuaries. It has, instead, been necessary to make use of a combination of standard oceanographic procedures and estuarine techniques.

Pratt, S.D. 1973. Benthic fauna. Pages 5-1 - 5-55 Coastal and Offshore Environmental Inventory. Cape Hatteras to Nantucket Shoals. Volume Marine Publication Series No. 2. University of Rhode Island, Kingston, RI.

Abstract: An assessment of bottom-dwelling invertebrate resources on the continental shelf between Cape Hatteras and the Nantucket Shoals. Exploitation of shelf areas is accelerating throughout the Mid-Atlantic Bight. New activities such as mineral recovery, compete with those activities displaced from estuaries, such as spoil disposal, and with the traditional but expanding activities of fishing, recreation, navigation, and cable transmission. Discusses level bottom assemblages (*i.e.* continental shelf, submarine canyons, beaches, estuaries *etc.*) and epifaunal assemblages (intertidal, subtidal, epiphytic) as well as specific non-commercial benthic fauna.

Pratt, S.D., A.R. Ganz, and M.A. Rice. 1992. A Species Profile of the Quahog in Rhode Island. Prepared for Rhode Island Sea Grant Program. Rhode Island Sea Grant Program. Kingston, RI. 117 pp.

Abstract: The quahog is a resource of major economic importance in Rhode Island and is the most important commercial species managed solely by the state. Throughout the state, large areas of potentially productive beds are closed due to poor water quality. The need to protect areas presently harvested and to expand harvested areas has been an important argument in recent and projected future upgrading of sewage treatment in Rhode Island. While summary reports have been completed on the safety of quahogs for consumption and problems of contamination by pathogenic microbes, the NBP reports are often large, do not focus specifically on quahogs, and, in some cases, need additional interpretation to be of use to fishery managers. This is a species profile, incorporating natural history, physiology, ecological aspects, effects of pollution, and population ecology.

Pratt, S.D., C.A. Griscom, and R.A. Heavers. 1975. Survey of Currents, Water Turbidity, and Benthic Biology in the Vicinity of Browns Ledge, Rhode Island Sound. Marine Experiment Station, University of Rhode Island. Kingston, RI.

Abstract: A survey of a proposed dredge disposal site (Brown's Ledge) 17 miles from the mouth of the Narragansett Bay. The survey took measurements on Turbidity, Benthic biology, and currents. This survey is to provide a basis for future detailed fieldwork in the area and for an environmental impact statement on the effect of spoil disposal there.

Pratt, S.D. and R.M. Heavers. 1975. Background Turbidity Conditions of Rhode Island Sound and Buzzards Bay. SR-5 Marine Experiment Station, Graduate School of Oceanography, U.R.I.

Abstract: The impetus for this survey was the need to know the natural levels and variations in turbidity in Rhode Island Sound in order to identify mechanisms of sediment resuspension and transport and the possible effects of dredged sediment disposal. The results suggest that spoil derived turbidity could be easily detected close to the disposal site, but that patches of turbid water would make monitoring very difficult at a distance of miles. It was concluded that fish movements should be examined for correlation with turbidity "fronts" and "floors" in the Sound and that turbidity should be used as an indicator of stratification in sampling for all oceanographic variables.

Pratt, S.D., S.B. Saila, and M.P. Sissenwine. 1973. Dredge Spoil Disposal in Rhode Island Sound. University of Rhode Island.

Abstract: The third study on the effects of dredge spoil disposal in Rhode Island Sound (see Saila et. al for second study). Present study was designed to bring the physical description of the spoil up to date, follow

the progress of recolonization of benthic animals, examine the quality of sediments exposed on the spoil surface, examine water turbidity in the dump-site area, make observations on the natural history of important animals in regard to possible effects of spoil, and examine records for the trap fishery in RIS to determine whether recent catch reductions can be related to spoil disposal.

Prescott, R.L. 1988. Leatherbacks in Cape Cod Bay, Massachusetts, 1977-1987. NOAA Tech. Memo. NMFS-SEFC-214. Pages 83-84 Schroeder, B. (Ed.), Proceedings of the Eighth Annual Workshop on Sea Turtle Conservation and Biology. 136.

Abstract: The presence of the leatherback in the waters surrounding Cape Cod, Nantucket, and Martha's Vineyard is well documented. Bleakney (1965), Lazell (1980), and a number of additional reports clearly indicate that the leatherback is a regular migrant through our study area.

Utilizing reports of live leatherbacks and recoveries of stranded leatherbacks, we are able to ascertain the causes of mortality, identify high use areas, and possibly determine how many leatherbacks frequent the waters surrounding Cape Cod and the Islands. In addition, through the study of stranded or entangled leatherbacks, we have been able to determine the general condition, size, and sex of those individuals present in the study area.

The study area includes the waters of the Atlantic Ocean, Vineyard and Nantucket Sounds, and Cape Cod and Buzzards Bays. Information was solicited from the public through the use of posters in 1980 and 1987, and annually through the news media, Massachusetts Audubon Society newsletters, lectures, and interviews with boaters, commercial and recreational fishermen, beach walkers, natural resource officers, and volunteers.

Pruell, R.J. and J.G. Quinn. 1985. Geochemistry of Organic Contaminants in Narragansett Bay (Rhode Island USA) Sediments. Estuarine, Coastal and Shelf Science. 21(3):295-312.

Abstract: Organic contaminants from several different chemical classes were analyzed in surface sediments along a transect from the head to the mouth of Narragansett Bay. The chemical classes included total hydrocarbons, polycyclic aromatic hydrocarbons, substituted benzotriazoles and phthalic acid esters. Sediment concentrations of all compounds were highest in the Providence River and decreased with distance downbay. The observed decreases were approximately exponential for all compounds; however, the distances at which the concentrations decreased to one-half of their initial concentrations (half-distances) were different. The depth distributions of these compounds in sediment cores from three locations were also investigated. A sediment core collected near the head of the bay (Conimicut Point) showed a well defined historical record of contaminant input to the bay. At a mid-bay location (North Jamestown), however, the record was smeared because of extensive bioturbation. A sediment core collected near the mouth of the bay (Rhode Island Sound) showed a subsurface increase for all of the measured compounds. The results of detailed analyses suggest that this horizon may have been influenced by dredge spoil material originally from the head of the bay.

Quinn, E., K. Paradise, and J. Atema. 1998. Juvenile *Limulus polyphemus* Generate Two Water Currents that Contact One Proven and One Putative Chemoreceptor Organ. Biological Bulletin. 195(2):185-187.

Abstract: In contrast to mandibulate arthropods, horseshoe crabs have no antennae. The absence of such chemo- and mechanoreceptive appendages invites questions about the mechanisms involved in bringing odor to the chemoreceptor organs, the gnathobases and the dactyls. Selective chemoreceptor lesion experiments of these organs in our laboratory have shown that locating distant food-odor sources is dependent on the gnathobases, whereas the dactyls are involved in local grasping for food, A third, putative, chemoreceptor organ is the flabellum, located laterally to the last pair of legs. Flabella are not involved in regulating respiration despite their location in the major respiratory water current. We investigate here the currents that may carry odor to both the known and the suspected chemoreceptor organs. We tested six juvenile *Limulus polyphemus*, ranging in size from 5 to 8 cm (prosomal width), collected from a salt marsh on the east shore of Buzzards Bay, Massachusetts.

Rank, P.H., C.E. Grosch, S.J. Lukasik, and G.W. Zepko. 1967. The Directional Swell Spectrum off Block Island. Davidson Laboratory Technical Report 1155. Stevens Institute of Technology. Hoboken, NJ.

Abstract: An array of four pressure gauges was used to measure the swell off Block Island, Rhode Island. The data were analyzed to obtain the directional wave spectrum. Resulting directional information agreed with visual observations at the time of the experiment.

Reback, K.E. and J.S. DiCarlo. 1972. Final Completion Report Anadromous Fish Project. Publ. #6496 (115-50-12-72-CR). Massachusetts Division of Marine Fisheries . Boston, MA. 113 pp.

Abstract: One hundred and forty-seven Massachusetts coastal streams and salt ponds were surveyed to determine the suitability for restoration or improvement of anadromous fish populations. Emphasis was placed on alewives, shad and smelt.

Eighty-five fishways were inspected and their condition noted. A priority list for fishway construction and improvement was developed. Construction of 17 fishways and improvement of 19, utilizing more efficient designs, was recommended. It was recommended that alewife propagation be continued, based on an annual evaluation of needs. Eight rivers have potential for shad restoration. Restoration of shad in the Taunton River system was initiated through the planting of fertilized eggs. It was felt that propagation of smelt, while feasible, was not of high priority because of limited utilization of the resource. It was proposed that the closed season for smelt be repealed on several streams and that a regulated fishery be conducted on an experimental basis to determine the possibility of increasing the utilization of this species.

Management of alewife fisheries is primarily the responsibility of the Commonwealth. Due to the large number of runs and the inherent maintenance and enforcement problems, local control of the fishery, with approval of the Division, would be more efficient. It was recommended that towns assume control under Section 94 of Chapter 130 of the General Laws.

Reeves, R.R., J.M. Breiwick, and E. Mitchell. 1992. Pre-exploitation abundance of right whales off the eastern United States. Northeast Fisheries Science Center Reference Document No. 92-05. Pages 5-7 (James Hain), The Right Whale in the Western North Atlantic: A Science and Management Workshop, 14 - 15 April 1992. Silver Spring MD., National Marine Fisheries Service. Woods Hole, Mass.

Abstract: In the literature it is often implied, if not stated explicitly, that right whales were present in large numbers in the western North Atlantic at the time of European discovery and colonization. Schevill, Watkins, and Moore (1986) offered a contrary view for one region, noting that their own “encounter rate” (our term) with right whales off Cape Cod was not much different from that reported by Allen (1916) for the Colonial period. Although they acknowledged that many whales might have been missed by both sets of observers (Woods Hole researchers and early European settlers), and that the number of whales present in recent years “would perhaps not have consistently supported the whaling that was carried on.” Schevill *et al.* challenged the conventional wisdom by suggesting that “the population of right whales passing near Cape Cod is at worst only slightly smaller now than it was in the 17th century."

Reeves and Mitchell (1987, 1988) compiled information on right whale kills by shore whalers between Maine and Florida from *ca* 1630 to 1930. Although this work revealed that Allen's (1916) compilation had been far from complete, the fragmentary nature of the (mainly) published records still made it impossible to conclude that there were more than a few hundred right whales in the population migrating along the U.S. East Coast in the early to mid-17th century.

Subsequent examination of unpublished records in British archives has made it possible to address somewhat more rigorously the problem of initial right whale abundance in this region.

Reeves, R.R., J.M. Breiwick, and E.D. Mitchell. 1999. History of Whaling and Estimated Kill of Right Whales, *Balaena glacialis*, in the Northeastern United States, 1620-1924. Marine Fisheries Review. 61(3):1-36.

Abstract: This study, part of a broader investigation of the history of exploitation of right whales, Balaena glacialis, in the western North Atlantic, emphasizes U.S. shore whaling from Maine to Delaware (from lat. 45 degree N to 38 degree 30'N) in the period 1620-1924. Our broader study of the entire catch history is intended to provide an empirical basis for assessing past distribution and abundance of this whale population. Shore whaling may have begun at Cape Cod, Mass., in the 1620's or 1630's; it was certainly underway there by 1668. Right whale catches in New England waters peaked before 1725, and shore whaling at Cape Cod, Martha's Vineyard, and Nantucket continued to decline through the rest of the 18th century. Right whales continued to be taken opportunistically in Massachusetts, however, until the early 20th century. They were hunted in Narragansett Bay, R.I., as early as 1662, and desultory whaling continued in Rhode Island until at least 1828. Shore whaling in Connecticut may have begun in the middle 1600's, continuing there until at least 1718. Long Island shore whaling spanned the period 1650-1924. From its Dutch origins in the 1630's, a persistent shore whaling enterprise developed in Delaware Bay and along the New Jersey shore. Although this activity was most profitable in New Jersey in the early 1700's, it continued there until at least the 1820's. Whaling in all areas of the northeastern United States was seasonal, with most catches in the winter and spring. Historically, right whales appear to have been essentially absent from coastal waters south of Maine during the summer and autumn. Based on documented references to specific whale kills, about 750-950 right whales were taken between Maine and Delaware, from 1620 to 1924. Using production statistics in British customs records, the estimated total secured catch of right whales in New England, New York, and Pennsylvania between 1696 and 1734 was 3,839 whales based on oil and 2,049 based on baleen. After adjusting these totals for hunting loss (loss-rate correction factor = 1.2), we estimate that 4,607 (oil) or 2,459 (baleen) right whales were removed from the stock in this region during the 38-year period 1696-1734. A cumulative catch estimate of the stock's size in 1724 is 1,100-1,200. Although recent evidence of occurrence and movements suggests that right whales continue to use their traditional migratory corridor along the U.S. east coast, the catch history indicates that this stock was much larger in the 1600's and early 1700's than it is today. Right whale hunting in the eastern United States ended by the early 1900's, and the species has been protected throughout the North Atlantic since the mid 1930's. Among the possible reasons for the relatively slow stock recovery are: the very small number of whales that survived the whaling era to become founders, a decline in environmental carrying capacity, and, especially in recent decades, mortality from ship strikes and entanglement in fishing gear.

Reeves, R.R., J.G. Mead, and S. Katona. 1978. The right whale, *Eubalaena glacialis*, in the western North Atlantic. 28th Report of the International Whaling Commission. SC/29/Doc 44:303-312.

Abstract: The right whale (*Eubalaena glacialis*) was once common along much of the eastern coast of North America and was subject to more or less intensive hunting over 400 years. Today it is rare, although sightings during the last quarter-century indicate that the species persists in this area. Besides providing evidence of the species' continued existence in the western North Atlantic, records during the post-whaling era have helped define its seasonal distribution and migratory movements. This paper: (1) summarizes information from the shore whaling period (through 1937); (2) summarizes available sighting and stranding records for the period of protection (since 1937); (3) discusses past and present evidence for a seasonal north-south migration; and (4) considers factors other than whaling that may continue to retard this stock's recovery.

A word of caution is in order concerning many of our data. No systematic effort has been made to census the population. Virtually all of the published and unpublished records were acquired opportunistically, often by untrained observers. Every effort has been made to verify species identification. Fortunately, trends in the data are unusually consistent, so an occasional mistaken identification does not reduce the reliability of our conclusions.

Regan, D.R. 1976. An Aerial Photogrammetric Survey of Long-term Shoreline Changes, Southern Rhode Island Coast.

Abstract: For shore protection analysis, the collection of data on coastal erosion by extensive field measurements is expensive and is complicated by the problem of extrapolating results obtained from short-term field observations into long-term erosional trends. On the other hand, surveys utilizing quantitative aerial photogrammetric techniques are less expensive than field surveys and accuracy on the order of three meters is possible. Aerial photographs show the location of the beach and features adjacent to the beach. These features can be used as stable locations to reference these shoreline and duneline photogrammetric measurements.

Photogrammetric measurements of the distance from a stable reference location to the dune and high tide lines were made at 300 m. (100 ft.) intervals along the Rhode Island shoreline on four sets of aerial photographs taken between 1939 and 1972. These measurements were converted to ground distances by scale determination using ground control surveys and, subsequently, compared in order to determine shoreline changes over the study period. Shoreline changes were determined for the 11-year average time intervals among the four sets of aerial photographs and also, for the entire 330year study period. Mean annual amounts of change were also computed for each time interval and for the entire study period. The long-term trend of shoreline change was generally erosional, averaging 0.2 m./yr. (0.7 ft./yr.), but within shorter term (11-year) time intervals, considerable variation from this trend occurred. Locally, headlands or barrier beaches, on a shorter time basis, eroded or even accreted up to 2.0 m./yr., but in general, headlands and barriers both eroded an average of 20 cm./yr. or about 6-7 m. over the 33-year study period. Contrary to a model of a submerging shoreline with headland erosion and barrier accretion, the entire Rhode Island shoreline appears to be eroding. Locally, sea level rise has averaged 0.3 cm./yr. over the past 40 years, or accountable for about 15 percent of the vertical component of average shoreline retreat for Rhode Island.

Shoreline readjustment on an offshore profile of equilibrium according to the Bruun model, is by deposition equal to the rate of sea level rise. On a submerging shoreline, beach erosion occurs if no other sediment source is available, as in the case of the Rhode Island shore. With the above rate of sea level rise, the potential sediment loss from the Rhode Island beaches to maintain equilibrium is 1500 times greater than the actual loss of material along this shoreline as determined in this study.

Rhoads, D.C. 1967. Biogenic Reworking of Intertidal and Subtidal Sediments in Barnstable Harbor and Buzzards Bay, Massachusetts, USA. Journal of Geology. 75(4):461-476.

Abstract: Biogenic reworking of marine sediment is described from intertidal deposits in Barnstable Harbor and subtidal sediments of Buzzards Bay, Massachusetts. Reworking activities of three polychaete species were studied in Barnstable Harbor: *Clymenella torquata, Pectinaria gouldii,* and *Amphitrite ornata*. Sediment reworking by these tube-dwelling annelids is primarily a vertical and lateral size-sorting process. The selective ingestion and transportation of sand and smaller-sized particles leads to the formation of biogenically graded deposits. *Clymenella* is estimated to ingest 274 ml. of sediment per worm per year. *Pectinaria* ingests 400 ml. of sediment per worm per year according to Gordon (1966). The annual reworking rate of *Amphitrite* remains unknown, but probably exceeds that of *Clymenella* and *Pectinaria*.

Five stations in Barnstable Harbor were artificially laminated with colored sand horizons to observe biogenic reworking at depth within the sediment. After 2 months, differences in intensity of reworking between stations appeared to be related to faunal composition rather than to faunal density. Tidal flats populated by low densities of predators were more highly reworked than stations populated by relatively high polychaete densities. Disturbance of the artificial laminae was found to be most intense in the upper 10 cm. of sediment (near surface predators). Reworking by polychaetes extended to a depth of 30 cm.

Artificial lamination of subtidal Buzzards Bay sediment revealed extensive reworking of the upper 2-3 cm. of sediment after a 2-month period. Infaunal activity was restricted to a depth of 10 cm. *Yoldia limatula* (bivalve) was primarily responsible for extensive near-surface reworking. *Nucula proxima* (bivalve) and

Nepthys incisa (polychaete) are also important reworking organisms in Buzzards Bay.

Rates of biogenic reworking recorded in this study indicate the importance of benthic organisms as agents of sediment digenesis.

Differences in burrowing depth between intertidal and subtidal environments may prove valuable for paleoecologic determination of onshore-offshore facies relationships. Deep vertical burrowing (to a depth of 30 cm.) is common in nearshore environments, especially in intertidal sediments. Shallow horizontal burrowing (to a depth of 10 cm.) is best developed in offshore level bottoms. Burrowing attitude may be observed in vertical thin sections of sediments that otherwise lack fossils, permitting paleobathymetric analysis of unfossiliferous as well as fossiliferous deposits.

Rhoads, D.C. and L.F. Boyer. 1982. The Effects of Marine Benthos on Physical Properties of Sediments: A Successional Perspective . Plenum Press. New York.

Abstract: This chapter is focused on the physical organism-sediment relations that are of potential value in predicting the physical properties of sediments and the transport fates of fine-grained sediments and the associated contaminants. Discussion is limited primarily to macrofaunal effects on subtidal muds. Focuses on how organism-sediment relations develop during ecological succession of the seafloor. A few measurement and observational techniques are offered.

Rhoads, D.C. and J.D. Germano. 1982. Characterization of Organism-sediment Relations using Sediment Profile Imaging: An Efficient Method of Remote Ecological Monitoring of the Seafloor (REMOTS™ System). Marine Ecology Progress Series. 8:115-128.

Abstract: A benthic successional model allows interpretation of structures observed in sediment profile images. From these structures, temporal and spatial changes can be deduced in both benthic habitat and its associated fauna. The instrument used for *in situ* remote monitoring is the Rhoads-Cande profile photographic camera or its updated version, the video REMOTS (Remote Ecological Monitoring Of The Seafloor) system. Sediment profile imaging has been used to characterize an estuarine pollution gradient in Narragansett Bay, Rhode Island and to monitor the _'August Effect" on benthic faunal dynamics in New Haven Harbor, Connecticut (USA). The ability of the profile camera to map rapidly patterns of seafloor disturbance and subsequent faunal change is described for a 1.5 mi^2 area near the Thimble Islands, Long Island Sound, Connecticut. We discuss the potential application of the REMOTS system for efficient monitoring of dredge-spoil activities and as a reconnaissance mapping tool for detecting change in benthic habitats in the region of outer continental shelf drilling fields.

Rhoads, D.C. and J.D. Germano. 1986. Interpreting Long-term Changes in Benthic Community Structure: A New Protocol. Hydrobiologia. 142:291-308.

Abstract: Documentation of long-term change in benthic ecosystems is important for assessing and managing the effects of such change on: 1) secondary production, particularly leading to commercially important food webs, 2) pollutant transfer within the food web, 3) the ability of the 'new' assemblage to metabolically burn-off labile detritus that might otherwise accumulate, contributing to long-term hypoxia, and 4) recycling of nutrients from the seafloor back to primary producers.

Organism-sediment relationships, which accompany benthic disturbances, have predictable features. Although participating species may vary regionally or seasonally, their life-history attributes and functional relationships to the associated sediment appear to be universal. Pioneering seres are near-surface dwelling, productive, and are readily available to demersal predators. However, these taxa may be potential pollutant vectors. Dense tube mats may promote the deposition and retention of high BOD organic matter. Late successional stage seres are represented by deeply bioturbating :head-down' deposit feeders. The deep cryptic infaunal habitat of these species may make them less important as prey for epifaunal predators.

Sediments populated by these equilibrium assemblages are characteristically low in labile organic matter, sedimentary sulphides, and oxygen demand. Nutrients (N, P, Si) are returned to primary producers by biogenic irrigation of sediment pore water.

Mapping of successional mosaics is important for documenting major long-term change in benthic community structure and associated biogenic processes. Our mapping tool consists of a vessel-deployed sediment-profile camera; organism-sediment relationships can be imaged *in situ* with this instrument. Such a mapping protocol is not intended to replace traditional sampling. Rather, the successional maps are used to efficiently detect change in a system, design a cost-efficient sampling grid for obtaining geochemical and biological ground-truth samples, and to construct hypotheses about how the change might answer the four outlined management questions.

Rhode Island Department of Administration. 1986. The Rhode Island Coastal Resources Management Program (CRMP): A Working Paper for Land Use: 2010. Rhode Island Department of Administration, Division of Planning. Providence, RI.

Abstract: This technical paper on Rhode Island's coastal resources is the second in a series of background papers being developed in conjunction with an update to the 1975 State Land Use Policies and Plan. The purpose of this series of papers is to present information about specific areas that have direct bearing on land use, emphasizing developments since 1975 and identifying issues that are likely to remain or become significant in coming years. It should be understood that the focus of each paper is the relation of its subject to land use.

Rhode Island Department of Environmental Management. 2000. Narragansett Bay Water Quality: Status and Trends 2000. Narragansett Bay Estuary Program, Narragansett Bay Estuarine Research Reserve.

Abstract: The water quality of Narragansett Bay is the result of many factors, both environmental and human. Current efforts to improve the Bay's water quality use environmental regulations based on state and federal environmental legislation, as well as technical outreach and education, to address the historic and ongoing pollutant sources discharging into this unique watershed. Twenty-five years of enforcement of Federal and State clean water laws have resulted in profound improvements in Narragansett Bay water quality. Some major pollutant issues are 1) a clear North-South pollution gradient in the Bay, with the highest pollutant levels in the urbanized Providence/Seekonk tidal rivers and the Fall River/Taunton River area; 2) Upgrading the municipal wastewater treatment facilities has reduced the biochemical oxygen demand that these facilities had placed on the Bay ecosystem; 3) Pretreatment requirements imposed on businesses that use metals through a variety of industrial processes has reduced the amount of metals discharged in wastewater.

At the same time, more remains to be done to achieve the consistently high levels of water quality that Rhode islanders desire and the Federal laws require. Problems that still exist include combined Sewer Overflows that cause raw, untreated sewage to flow into the Bay after heavy rains; nutrient inputs into the Bay, particularly nitrogen, are not yet dealt with; and in unsewered communities, older failing septic systems can contribute significantly to bacterial and nutrient loading. Presently there is inadequate data to judge quantifiable trends in habitat loss and cost-effective long-term monitoring and special surveys are needed to identify new or previously unidentified sources of pollution that impact water quality.

Rhode Island Division of Fish and Wildlife. 1992. Dredging Policies for Rhode Island Waters. Rhode Island Division of Fish and Wildlife.

Rhode Island Division of Fish and Wildlife. 1997. Shellfish Map Supplied to the U.S. Army Corps of Engineers. Rhode Island Division of Fish and Wildlife.

Rhode Island Marine Trade Association and Daniel S. Natchez and Associates, Inc. 1985. The Need for and Economic Impact of an Open Water Disposal Site for Dredged Materials for the Coastal Rhode Island Water-Dependent Marine Industries.

Abstract: Based on the survey response, there is a significant need for the establishment of an environmentally safe and economically affordable open-water disposal site. The dredging needs for Coastal Rhode Island Water-Dependent Marine Industries were identified as a minimum of approximately 11.6 million cubic yards -- of which 95% (or approximately 11.0 million cubic yards) have no available upland disposal site. Further, the Army Corps of Engineers has identified approximately 400,000 cubic yards of additional Corps' dredging projects without any upland disposal site(s). If an open-water disposal site were opened in Rhode Island's coastal waters, it is believed that additional channel and 'fairway' dredging projects for the Corps, other governmental agencies, and private concerns would be identified -- significantly increasing the amount of dredging to be undertaken. Almost the entire dredging needs were identified without quantifying channel and/or 'fairway' needs despite identification of concerns of future insufficient depths in the channels and 'fairways' by approximately 63.4% of those responding to this question (Chart "8.2 - D").

Rhode Island Parks and Recreation. 2002. Listing of State Parks and Beaches: State of Rhode Island

Abstract: A listing of all Rhode Island State parks and beaches from the State of Rhode Island website in 2002.

Rice, M.A. 1996. The 1995 Status of the Shellfisheries for the Northern Quahog, *Mercenaria mercenaria* (L.) in New England. Journal of Shellfish Research. 15(2):481.

Abstract: Fisheries for northern quahogs (Mercenaria mercenaria) in the southern New England region have been in existence since pre-colonial times, and as recently as the middle 1980s the major fishery market source area. Since the late 1980s, there have been declining catches in New England and increasing market supplies of quahogs from the Middle Atlantic and Southern States due to relay, depuration, and aquaculture programs. Commercial quahog landings in the three major producing states in New England, Massachusetts, Connecticut and Rhode Island were 34,659 bu (188 metric tons meat weight), 187,240 bu (1017 mt) and 134,417 bu (730 mt) respectively in 1994. Since 1990, landings of quahogs in Connecticut have increased largely due to introduction of containerized and bag relaying of product from conditional pollution closure areas. There has been a decline in the landings in Massachusetts and Rhode Island over the same period of time. The condition of quahog stocks in Massachusetts and Rhode Island are not particularly poor, as catch per unit effort has been steady. Lowered catches in these states has been largely driven by the economics of the fishery. The low capitalization required by the quahog fishery (mostly bullrakes) allows fishermen to leave the profession as quickly as they can enter. For example during the mid-1980s when quahog prices were relatively attractive, there were about 800 full time shellfishermen in Rhode Island, but now there are only about 200. These remaining shellfishermen are individually catching as many quahogs as they had previously, but their overall income is down. It is recommended that greater attention to cooperative marketing by the fishermen can lead to greater economic returns.

Rice, M.A. 1993. Overview of Quahog Management Studies in Narragansett Bay, 1946 to 1992. Pages 49-61 In: Rice, M.A. and D. Grossman-Garber. (Eds.), Proceedings of the Second Rhode Island Shellfish Industry Conference, Narragansett, Rhode Island, August 4, 1992. Rhode Island Sea Grant Report . Narragansett, Rhode Island.

Abstract: Study on quahog (Mercenaria mercenaria) populations in Narragansett Bay has provided valuable information for fisheries managers. A few socioeconomic studies have characterized the labor force in the quahog fishery and have provided information pertinent to levels of fishing effort. Most ecological studies have focused on the population structure and standing crop of quahogs in Narragansett Bay. The age and growth rates of quahogs in different parts of the Bay are well known, but there is a dearth

of information about the patterns of quahog recruitment. The levels of fishing effort in Narragansett Bay to increase or decrease as conditions in the fishery or the general economy change. It is recommended that available socioeconomic data about the fishery be updated, and that studies be undertaken to assess the relative impacts of currently used fishing gear.

Rice, M.A. 1999. Uptake of Dissolved Free Amino Acids by Northern Quahogs, *Mercenaria mercenaria,* and its Relative Importance to Organic Nitrogen Deposition in Narragansett Bay, Rhode Island. Journal of Shellfish Research. 18(2):547-553.

Abstract: Studies were undertaken to determine the relationship between size of northern quahogs Mercenaria mercenaria and the rate at which they transport aspartic acid. Quahogs ranging from 25 to 103 mm valve length were collected in Narragansett Bay and placed in seawater aquaria (27 ppt, 20 °C) and allowed to pump water actively. Uptake experiments were carried out using 1 mumol/L C SUP 1 SUP 4 radiolabeled aspartic acid. Aspartate transport rates in mumol/h can be related to valve length by the allometric equation with a = 24.32 and b = 0.905 when valve length is in mm. In May 1990, near-bottom samples of seawater were taken from five locations in Narragansett Bay for analysis of dissolved free amino acids (DFAA) by high-pressure liquid chromatography (HPLC). Results showed that the mean total DFAA concentration was 667.6 nmol/L +/- 167.3 SD, with the top five being serine, alanine, aspartic acid, glutamic acid, and glycine. A simple spreadsheet model was used to assess the relative importance of the uptake of DFAA vis-à-vis the filtration of particulate organic matter by M. mercenaria. In the model, environmental DFAA concentrations and uptake rates by quahogs determined in this study are compared with literature values for particulate organic nitrogen concentrations and filtration rates by quahogs. On an annual basis, uptake of DFAA can account for about 14% of the total organic nitrogen uptake by quahogs. Uptake of DFAA by these benthic filter feeders may be a pathway of benthic-pelagic nutrient coupling that is often overlooked in coastal ecosystem analyses.

Rice, M.A. and J.E. Goncalo. 1995. Spatial and Temporal Distribution of Bivalve Larvae in Greenwich Bay, Rhode Island, during the Summer of 1993. Journal of Shellfish Research. 14(1):246-247.

Abstract: Greenwich Bay, in Narragansett Bay, RI, is known to be an area that has supported recreational and commercial fisheries of the northern quahog, Mercenaria mercenaria. Sustained annual catches of approximately one million pounds of mostly smaller-size “littlenecks” in the bay suggest annual recruitment, but few studies of early life history stages have been undertaken in this area since Landers showed maximum bivalve abundance occurred during the month of June in 1951 and 1952. Weekly water samples (100-L each) were taken on an incoming tide from 0.3 and 1.5 m depths at seven locations in Greenwich Bay: Greenwich Cove, Mary's Creek, Nausauket, Oakland Beach, Goddard Park, Sally Rock, and the mouth of Greenwich Bay. The Greenwich Cove and Mary's Creek sites were chosen because they are closed to shellfishing and have large adult quahog populations in excess of 90 animals/m super(2). Samples were taken using a 20 L/min, 12V-electric bilge pump and passing the water through a 60- mu m mesh plankton net. Larvae were fixed in the field with 10% buffered formalin in filtered seawater and transferred to a 25% ethanol/seawater mixture for storage. Larvae in duplicate 1.0 mL subsamples of the preserved samples were identified and counted. Larvae from several invertebrate and vertebrate taxa were identified. Identifiable bivalve larvae were distinguished as to development stage: D-hinge veliger, umbonate veliger, and pediveliger. Maximum bivalve abundance occurred June 14 at all of the sites with a bay-wide average of 7,800 larvae/100L. A secondary peak of abundance occurred August 3 with 580 larvae/100L. The D-hinge veligers were much greater in number then umbonate veligers, which in turn were greater in number than pediveligers. This suggests predation loss or export of the developing larval stages. Larvae were not uniformly distributed throughout Greenwich Bay. Maximum bivalve larval abundances were found in the open bay sites rather than in coves and inlets. This is a surprising result because presumed “spawner stocks” reside in the coves. Further studies are needed to identify the most probable sources of larvae leading to quahog recruitment in Greenwich Bay. This is publication 3044 of the Rhode Island Agricultural Experiment Station. (DBO)

Rice, M.A., M. Grady, and M.L. Schwartz. (Eds.). 1991. Proceedings of the First Rhode Island Shellfisheries Conference. Narragansett, RI, August 27, 1990.

Abstract: Narragansett Bay has been considered the greatest natural resource of Rhode Island, supporting a variety of activities including recreational boating, swimming and other aquatic sports, transportation and shipping, and recreational and commercial fishing; as well as the simple, quiet enjoyment of the aesthetics of the coast. Narragansett Bay also serves as a dumpsite for many of the unwanted byproducts of our modern society. Inevitably, conflicts arise from the multiple uses of the Bay and other coastal waterways.

The commercial shellfishing industry of Rhode Island annually provides $15 million (ex-vessel price) in quahogs (*Mercenaria mercenaria*) to seafood markets. This fishery, the largest in Rhode Island state waters, provides a livelihood for about 800 full-time fisherman. Quahogs and other bivalve mollusks are filter-feeders that accumulate pollutants ranging from metallic and organic chemicals to pathogenic bacteria and viruses. No one wants to see public health threatened by contaminated shellfish, but areas closed to shellfishing harbor a tremendous potential resource. Fishing pressure in the areas open to shellfishing is a problem. The shellfishing industry, more than just about any other, depends upon a high degree of water quality.

This volume presents papers delivered at the First Rhode Island Shellfisheries Conference, cosponsored by the Rhode Island Shellfishermen's Association, Rhode Island Cooperative Extension Service, and Rhode Island Sea Grant. The aim of the conference was to provide an educational forum and a starting point for the rational resolution of multiple-use conflicts.

Rice, M.A., C. Hickox, and I. Zehra. 1989. Effects of Intensive Fishing Effort on the Population Structure of Quahogs, *Mercenaria mercenaria*, (Linnaeus 1758), in Narragansett Bay. Journal of Shellfish Research. 8(2):345-354.

Abstract: Quahogs, *Mercenaria mercenaria*, and sediment samples were collected from three locations in Narragansett Bay: Greenwich Cove, Greenwich Bay, and the West Passage of Narragansett Bay. Greenwich Cove has been closed to shellfishing for several decades. The average density of quahogs in the cove was 190/m , ranging from 32m -500/m in 30 quadrats. The average valve length of quahogs in Greenwich Cove was 62 mm. Adjacent to Greenwich Cove in Greenwich Bay, which has been heavily fished since 1930s. The average density of quahogs in Greenwich Bay was 78/m , ranging from 8/m2-184/m . The average valve length was 31 mm. There were no significant differences in salinity, Secci disk turbidity or total organic content of sediments between these two sites. There was a slightly higher content of very fine-grained sands (<125 mm), silts, and clays in the Greenwich cove sediments. The average Mercenaria density at another closed site on the West Passage of Narragansett Bay was 46/m with an average valve length of 61 mm. The lower density may be due to higher silt and clay content of the sediments. There were significantly more juvenile (<40 mm) quahogs in the heavily fished area $p < 0.01$, ANOVA). Determination of age by shell growth rings showed that quahogs in the bay were 12 years of age or less. Ages were greater in the closed areas and exceeded 25 years in the largest individuals. Growth data from quahogs in the closed areas was fit to the von Bertalanffy growth equation. This yielded asymototic valve length maxima (L) of 110 mm ± 9.6 (SE) in the West Passage and 86 mm ± 4.7 (SE) in the cove, suggesting density-dependent stunting in the latter site. Active fishing tends to remove adults from the population and enhance either the set or survival of juvenile quahogs. The mechanism for increasing the juvenile density is not understood; possible explanations include removal of competing adults and sediment disturbance/turnover as a result of the fishing methods. Reburrowing of quahogs placed on the sediment surface was studied. Results indicate that the largest adults (>86 mm valve length) have the least ability to reburrow.

Rice, M.A., A. Valliere, and A. Caporelli. 2000. A Review of Shellfish Restoration and Management Projects in Rhode Island. Journal of Shellfish Research. 19(1):401-408.

Abstract: Shellfish management and restoration efforts in Rhode Island date back to the late 19th century. From the late 1890s to the Second World War the Rhode Island Fisheries Commission operated a lobster

hatchery in Wickford Harbor in response to a perceived decline in lobster catches in Narragansett Bay. Berried lobsters were collected, eggs hatched, larvae reared, and postlarval fifth stage juveniles were released to the bay. The project was discontinued primarily because of costs and a failure to demonstrate the efficacy of juvenile seeding in improving lobster catches. From the 1930s to the 1980s, there have been several similar efforts to establish hatcheries to produce juvenile bivalve mollusks for public and private reseeding efforts, but none of these efforts were economically sustainable. The longest running efforts to improve shellfisheries have been state programs to relay northern quahogs, Mercenaria mercenaria, from dense population assemblages in waters closed to shellfishing. Large-scale relays began in the 1950s in response to heavy fishing pressure but ended in the 1960s when commercial power dredging for shellfish was banned in Narragansett Bay. A small-scale state program existing since the late 1970s pays a modest fee to supervised shellfishers for hand digging quahogs in closed waters and planting them in management areas for depuration and eventual harvest. The amounts of shellfish relayed annually have varied widely since 1977, ranging between 7 and 322 metric tonnes, with an average of 98 metric tonnes per year. A new relay program has been underway since 1997. It involves assessing the shellfish stocks in the closed Providence River and hiring dredge boats to relay shellfish into down bay management areas. Based on maximum sustainable yield (MSY) considerations, annual relays should not exceed 10.3% of the standing crop (or 2721 metric tonnes) in the Providence River. An effort to restore lobsters onto monitored artificial reefs is underway using settlement funds from a 1989 oil spill in Narragansett Bay. Finally, the Rhode Island Public Benefit Aquaculture Project, a joint educational effort with commercial fisheries involvement, is involving secondary level students in the nursery culture of shellfish (though marina-based upwellers) for seeding of public shellfish beds.

Rice, M.A., A. Valliere, M. Gibson, and A. Ganz. 2000. Ecological Significance of the Providence River Quahogs: Population Filtration. Journal of Shellfish Research. 19(1):580.

Abstract: Filter feeding by populations of bivalves has been suggested as a means of reducing eutrophication in coastal estuaries by exerting control of phytoplankton populations in the water column. Frequently, large populations of mature shellfish residing behind pollution closure lines in estuaries represent a large filter feeding biomass. The standing crop of quahogs, *Mercenaria mercenaria*, in the Providence River averages 9.1 clams/m² or about 26,400 tonnes, filtering about 1.05×10^7 m³ of water daily or a rate equivalent to 21% of the rate of water exchange during a tide cycle. Due to annual temperature effects, population filtration ranges from 0 in the winter to 2×10^7 m³/day in August. The population of quahogs, however, is composed of mostly older adults with valve lengths in excess of 60 mm. These large animals are slow growing, have a low rate of secondary production in relation to standing crop biomass, and have a neutral nitrogen balance (organic-N assimilated = NH_3-N excreted). These large adults increase sedimentation through filter feeding, but since they are neither harvested nor growing they do not directly remove much nitrogen from the system, although the increased sedimentation rates may result in increased sediment denitrification. Filtration by the standing crop of quahogs may remove 76.2 tonnes of organic nitrogen annually. As part of a Narragansett Bay wide shellfisheries management plan, 10% of the standing crop of quahogs in the Providence River is recommended for relay to management beds down bay for later harvest. Smaller more rapidly growing quahogs have the capability of incorporating organic nitrogen into growing tissues and, if harvested regularly, provide a mechanism for direct removal of nitrogen from the estuary. The removal of quahogs from the dense assemblages in the Providence River reduces the population filtration by only 10%, but it culls the population making room for faster growing juveniles and small adults.

Riess, W. 2001. Database on Shipwrecks collected by Dr. Warren Riess, Research Associate and Processor of History and Marine Sciences of the University of Maine's Darling Marine Center.

Abstract: The University of Maine's Darling Center maintains a database of all known shipwrecks noted during the various studies performed by the center. This database is quite comprehensive for the northeast region. Searches of the database can be purchased through Dr. Warren Reiss of the University of Maine or Dr. Mitch Mulholland of the University of Massachusetts- Amherst.

Riley, G.A., G.B. Deevey, D. Merriman, R. Sclar, and H.L. Sanders. 1952. Hydrography and Biological Studies of Block Island Sound. Volume XIIII, Article 3. Peabody Museum of Natural History, Yale University. New Haven, CT. 237 pp.

Abstract: Contains six reports on the Long Island Sound and Block Island Sound area (1) Hydrography of the Long Island and Block Island Sounds; (2) Phytoplankton of Block Island Sound, 1949; (3) A survey of the zooplankton of Block Island Sound 1943-1946; (4) Quantity and composition of the zooplankton of Block Island Sound 1949; (5) The pelagic fish eggs and larvae of Block Island Sound; and The herring (*Clupea harengus*) of Block Island Sound.

Rinkel, L.A. and A.K. Valliere. 1995. Identification of Fishery Resources by Literature Search in the Proposed Dredge Disposal Sites in Narragansett Bay. Rhode Island Division of Fish and Wildlife, Coastal Fisheries Laboratory. Wakefield, RI.

Abstract: Nine cruises in the Long Island and Block Island Sounds in 1946 provide a basis for the description of temperature and salinity distribution in these waters. Data on tides, currents, and freshwater drainage are summarized, and all available information is combined into an analysis and discussion of the physical oceanographic processes that produce the observed distribution of temperature and salinity.

There is a slow southwesterly drift in the coastal waters off southern New England. Part of this water moves into the Sounds, particularly along the bottom, where it is gradually mixed with the products of river drainage; thus the salinity decreases from the open coastal waters toward the innermost ends of the sounds and bays. From these inner waters a compensating surface current moves seaward and joins the general coastwise drift.

L.I.S., being a semi-enclosed body of water, is particularly favorable for quantitative investigation of currents, mixing processes, and the total exchange with adjacent waters. The circulation is mainly controlled by river drainage. Addition of fresh water into the shore zone tends to produce a counterclockwise circulation; however, tidal mixing in areas of little river outflow breaks up the coastal density gradient. The net result appears to be a series of three main eddies counterclockwise in the east and west ends of L.I.S., with a clockwise eddy between.

The net transport of water from L.I.S. must equal the freshwater drainage, which amounted to 35% of the volume of this body of water in 1946. Observed surface currents indicate a much larger surface transport from L.I.S. into B.I.S., and this is part of the evidence favoring the existence of a two-layered transport system, with water flowing out at the surface and in at the bottom. To maintain the observed salinity in L.I.S., it was necessary for B.I.S. water to be brought in at a mean rate of 7500 m^3/sec, totaling 3.8 times the volume of L.I.S. during 1946. These figures represent the combined effects of lateral eddy diffusion and mass transport.

Although there is a slight seasonal variation in salinity in L.I.S., the salinity distribution tends to be self-regulating. With an increase in river drainage and a decrease in average salinity, there is an increase in the amount of exchange between the two Sounds, so that more B.I.S. water is brought in to counteract the freshening effect. It is suggested that a decrease in salinity increases the slope of the free surface between L.I.S. and the open sea and accelerates both the surface velocity and the compensating bottom current. Quantitative aspects of the theory are briefly examined.

Problems of turbulence are discussed from time to time, and coefficients of lateral eddy diffusivity and vertical eddy conductivity are evaluated. In B.I.S. the eddy coefficients and the observed salinity distribution are used to estimate current velocities.

Robb, J.M. and R.N. Oldale. 1987. Preliminary Geologic Report, Buzzards Bay, Massachusetts. USGS Misc. Field Stud. Map MF-889. U.S. Geological Survey .

Robinson, W.E., W.E. Wehling, and M.P. Morse. 1984. The Effect of Suspended Clay on Feeding and Digestive Efficiency of the Surf Clam, *Spisula solidissima* (Dillwyn). Journal of Experimental Marine Biology and Ecology. 74:1-12.

Abstract: Groups of 18–19 1-yr-old surf clams, *Spisula solidissima* (Dillwyn), were exposed to 0.1, 0.5 and 1.0 $g \cdot l^{-1}$ attapulgite clay suspensions for 3- and 21-day periods. Following treatment, clams were allowed to feed for 1 h in a 500-ml suspension of *Isochrysis galbana* Parke (25 $\mu g \cdot l^{-1}$ chlorophyll) and attapulgite, dosed at the concentration to which the clams were previously treated. Water samples (pre- and post-feeding), pseudofeces, and feces were collected, extracted in acetone, and analyzed for chlorophyll and pheopigment content. Results indicate that turbidity levels >0.1 $g \cdot l^{-1}$ attapulgite clay result in a significant increase of pseudofecal production and a decrease in the amount of algal food actually ingested. Mean chlorophyll consumption and digested chlorophyll levels were progressively lower and mean pseudofecal chlorophyll levels higher for groups treated with increasing concentrations of attapulgite. Fecal chlorophyll levels were low and variable. Digestive efficiency, defined as the percent of consumed chlorophyll, which was degraded to pheopigment during gut passage, was generally lower in clay-treated clams than controls. Surf clams treated for 21 days demonstrated an apparent acclimation to the 0.1 and 0.5 $g \cdot l^{-1}$ clay concentrations, showing greater mean chlorophyll consumption and digested chlorophyll levels than for the corresponding 3-day treated groups. The 1.0 $g \cdot l^{-1}$ turbidity level was beyond the animals' capability to acclimate. Although the concentrations of clay tested (100 to 1000 $mg \cdot l^{-1}$) were higher than levels generally encountered in continental shelf bottom waters (<5 $mg \cdot l^{-1}$), results of this study indicate that anthropogenic turbidity-producing discharges at levels as low as 100 $mg \cdot l^{-1}$ may have adverse effects on the energetics of surf clam populations.

Ropes, J.W., S.A. Murawski, and F.M. Serchuk. 1984. Size, Age, Sexual Maturity, and Sex Ratio in Ocean Quahogs, *Arctica islandica* Linné, off Long Island, New York. Fishery Bulletin. 82(2):253-267.

Abstract: Ocean quahogs, *Artica islandica*, were collected off Long Island, New York, in 1978 for a determination of sexuality and gonadal condition. A microscopic examination of histologically prepared tissues of 133 clams, 19-60 mm in shell length, revealed that 36 were in an undifferentiated condition and could not be sexed. Sexual differentiation was evident in 97 clams; of the latter, 69 were in two types of intermediate development: those with sparse (20) and moderate (49) tubule development. Only 28 clams were fully mature. Age and growth were assessed from acetate peels of shell cross sections. Determination of sex of these, and of specimens 57-103 mm in shell length collected from the same area in 1980, indicated that the smallest and youngest ocean quahogs were predominantly male, but the largest and oldest were predominantly female.

Rose, K.A., J.A. Tyler, R.C. Chambers, G. Klein-MacPhee, and D.J. Danila. 1996. Simulating Winter Flounder Population Dynamics using Coupled Individual-based Young-of-the-year and Age-structured Adult Models. Canadian Journal of Fisheries and Aquatic Sciences. 53(5):1071-1091.

Abstract: Population dynamics of winter flounder (Pleuronectes americanus) are simulated using a detailed individual-based model for young-of-the-year coupled to an age-structured matrix model for adults. When run alone, the young-of-the-year model is initiated with user-specified female spawners. When coupled to the adult model, multiple-year simulations are performed with young-of-the-year survivors inputted to the adult model and the adult model is used to generate the female spawners each year. Model predictions of young-of-the-year densities, growth rates, and mortality rates were within the range observed for the Niantic River population. Model predictions and Niantic River data both showed recruitment (survivors to age 1) to level off at high numbers of spawners. Predicted recruitment at high numbers of spawners was two to three times that for the same conditions under density independence. Analysis of a 200-year simulation indicated that recruitment was largely set by metamorphosis, with density-dependent growth and survival rates operating during the larval and juvenile life stages. The relationship of our modeling approach to previous approaches, the implications of our results to understanding winter flounder population dynamics, and possible further elaborations of the model are discussed.

Rosenberg, A.A. and S. Brault. 1993. Choosing a Management Strategy for Stock Rebuilding when Control is Uncertain. Risk Evaluation and Biological Reference Points for Fisheries Management. Canadian Special Publication of Fisheries and Aquatic Sciences. 120:243-249.

Abstract: For many marine resources, which are currently overexploited, the task of management is to devise a strategy for rebuilding the stock over a given period to restore productivity and stability to the fishery. Most studies have accounted for the inherent uncertainty in recruitment and some, for the measurement error in the assessment process. Another important source of variation is the ability of management to achieve a particular harvest rate in any one year. This study explores the effects of this source of uncertainty, which Pleuronectes ferrugineus is referred to as implementation uncertainty, on stock rebuilding strategies for southern New England yellowtail flounder. Simple random variation in fishing mortality rates does not substantially affect the expected yield and spawning biomass although it does modify the distribution of these quantities. However, when there is a relation between implementation uncertainty and stock abundance, the form of this relation is relevant. Regulation of effort that leads to switching between stocks causes an increased risk to the spawning biomass for similar yield patterns. Conversely, regulation through quotas produces lower expected yields but a higher expected spawning biomass.

Rosenberg, M.J. 1986. Geological Aspects of Shoreline Management: A Summary for Southern Rhode Island. II. Temporal Variability of Beach Profiles, Charlestown Beach, Rhode Island. Vol. 2. Technical Report No. 6-SRG. Volume 2. Dept. of Geology, University of Rhode Island. Kingston, RI.

Abstract: Beach profiles and littoral environment measurements from one site on Charlestown Beach, Rhode Island, have been used to determine various beach states and modes of variability over a five-year period. The major profile configurations of this microtidal beach, were classified by the wave climate responsible for their shape. Storm beaches typically exhibit a wide, concave beachface and landward-displaced berm crest. Post-storm recovery beaches are characterized by the rapid onshore migration and welding of swash bars to the concave beachface. Berm development is influenced by tidal conditions, wave climate, and pre-storm configuration, and occurs within 4-7 days. This recovery rate is more rapid than on mesotidal beaches due to the greater interaction time with wave processes during a tidal cycle. Mature beaches at Charlestown often consist of a high, wide berm with a flat to gently landward-dipping berm top and a steeply dipping beachface.

The storms found to cause the most beach erosion were either tropical or extratropical in origin but tracked closely to the west of Rhode Island. These storm paths produced southeasterly (onshore) winds of extended duration and incident waves with a long fetch. Intense storms (1-2 per year) cause extensive beach erosion (25-50 m^3m^{-1}) and may result in foredune retreat and/or backbarrier accretion by overwash. Moderate storms (6-7 per year) produce more frequent but smaller beach changes (10-20 m^3m^{-1}) such as storm berms/scarps, berm top runnels, and berm top or foredune accretion.

Short-term storm-fairweather (erosion-accretion) beach cycles were ubiquitous throughout the data set while longer-term seasonal fluctuations were identified only during the first three years. This temporal variation may result from sediment budget changes due to long-term storage, alongshore transport, and large-scale climatic fluctuations.

A principal components analysis of the data set produced three major modes of above mean low water profile change: 1) the 1st eigenfunction indicates an onshore-offshore transport of sediment (*e.g.* storms and accretionary periods), 2) the 2nd eigenfunction corresponds to a beachface-berm top exchange of sediment (*e.g.* berm erosive events and periods of greater berm top accretion than, or in conjunction with, beachface erosion, and 3) the 3rd eigenfunction is most applicable during infrequent foredune activity (*e.g.* erosion, overwash events, and dune fill).

A high correlation exists between profile volume and the 1st temporal coefficients. This indicates that the majority of changes in profile volume occur within the region of 1st eigenfunction profile variability and are interpreted to result from onshore-offshore transport.

The landward limit of 2nd eigenfunction profile variability may be used as an unbiased delimiter of the inland boundary of a coastal feature, from which coastal resource setback distances are measured. On Charlestown Beach, this corresponds to the middle of the foredune ramp, marking maximum dune erosion during the Blizzard of 6-7 Feb 1978. Due to the annual fluctuation of storm frequency and intensity, five years of profile data are more accurate than a single year for the determination of the inland boundary.

Rosenberg, R., B. Hellman, and B. Johansson. 1991. Hypoxic Tolerance of Marine Benthic Fauna. Marine Ecology Progress Series. 79:127-131.

Abstract: In stratified coastal marine waters hypoxia is a growing problem affecting bottom-dwelling animals. Earlier studies suggest oxygen concentrations of about 2 ml 1^{-1} (Rosenberg 1980) as the lower tolerance limit for many benthic species in coastal areas. We exposed several conspicuous infaunal species on the NE Atlantic continental shelf, contained within their sediment habitat, to gradually reduced oxygen concentrations. Tolerance to hypoxia for the 8 species examined was in the range of 0.5 to 1.0 ml 1^{-1} (8 to 15% saturation), which they could tolerate for several days to weeks. The ophiuroid *Amphiura filiformis* left its protected position in the sediment at an oxygen concentration of 0.85 ml 1^{-1} (13% sat.), whereas *A. chiajei* emerged from the sediment at 0.54 ml ^{1} (8% sat.).

Rosenfeld, L.K., R.P. Signell, and G.G. Gawarkiewicz. 1984. Tech. Rpt. WHOI- 84-5 (CRC-84-01). Hydrographic Study of Buzzards Bay, 1982-1983. Woods Hole Ocean. Inst. Woods Hole, MA. 140 pp.

Abstract: A series of four hydrographic cruises at three-month intervals was undertaken in Buzzards Bay in 1982-1983. Buzzards Bay is located on the southern coast of Massachusetts, west of Cape Cod. Listings and vertical profiles of one-meter-averaged values of temperatures, salinity, sigma-t and light transmission are presented. Selected vertical cross-sections of temperature, salinity and sigma-t are also included, as are horizontal maps of the same variables at depths of 1 m and 8 m.

Rough, V. 1995. Gray Seals in Nantucket Sound, Massachusetts, Winter and Spring, 1994. Final Report to Marine Mammal Commission in Fulfillment of Contract T10155615.

Ruggaber, G.J. and E.E. Adams. 2000. Dynamics of Particle Clouds Related to Open-Water Sediment Disposal: 2. Loss of Material During Convective Descent. In: Conference on Dredged Material Management: Options and Environmental Consideration. December 3, 2000-December 6, 2000. MIT Sea Grant College Program. Cambridge, MA.

Abstract: Open-water disposal and capping are promising solutions for disposal of the 14 to 28 million ml of contaminated sediment dredged annually in the United States. However, such practices raise concerns about the feasibility of accurately placing the material in a targeted area and the loss of material to the environment during disposal.

To investigate the question of sediment loss during disposal, laboratory experiments were conducted in a deep glass-walled tank using a quick-opening sediment release mechanism and a specially designed curtain shade serving as a “sediment “trap". Both non-cohesive and cohesive sediments were utilized under a variety of release conditions (varying initial momentum, water content, initial stirring, *etc.*). Data consisted of digital images of particle clouds illuminated by laser-induced fluorescence, and measurement of sediment mass captured on the trap at various stages of cloud descent.

Despite the fact that sediment was released nearly instantaneously, much of the material was never incorporated into the cloud. Most such material formed a narrow “stem” behind the cloud, with the stem containing as much as 30% of the original mass depending on the release conditions. Much of the stem

material either re-entered the cloud later in descent or reached the bottom shortly after the cloud. Material not incorporated into either the stem or the cloud could easily be advected off-target by ambient currents. However such material was found to account for less than 1% of the original mass.

Russell-Hunter, W.D. and R.F. McMahon. 1975. An Anomalous Sex-ratio in the Sublittoral Marine Snail, *Lacuna vincta* Turton, from near Woods Hole. The Nautilus. 89(1):14-16.

Abstract: Sampling of a natural population of *Lacuna vincta* Turton near Woods Hole, Massachusetts, over the summers of 1968-1973 showed significant differences between the sexes in mortality. By early July, after the principal reproductive period, all the larger snails in the population are male. This anomalous dimorphism is discussed in relation to the more usual pattern of large females surviving longer, and to alternative hypotheses regarding the bioenergetics of reproduction.

Sadove, S.S. and S.J. Morreale. 1990. Marine mammal and sea turtle encounters with marine debris in the New York Bight and the northeast Atlantic. NOAA Tech. Memo. 154. Pages 562-570 Shomura, R.S. and M.L. Godfrey. (Eds.), Proceedings of the Second International Conference on Marine Debris 2-7 April 1989. Honolulu, Hawaii, 1274.

SAIC. 1990. Index of DAMOS Contributions. Disposal Area Monitoring System DAMOSU.S. Army Corps of Engineers. 150 pp.

Abstract: The Disposal Area Monitoring System (DAMOS) was begun by the New England Division (NED) of the U.S. Army Corps of Engineers in 1977 to perform monitoring studies that would permit management of dredged material disposal effects. The results of these studies are presented in a series of DAMOS contributions and include information on dredged material disposal and its physical, chemical, and biological impacts on the environment. It is hoped that this index will facilitate the location of information of interest to the reader and, therefore, encourage its broad dissemination.

This document contains the index of each individual contribution prepared under DAMOS. In addition, a MASTER INDEX has been prepared that allows the reader to quickly locate the appropriate contributions containing information on the selected topic. A companion volume contains the indices for the SR-series of reports produced in the 1970s prior to DAMOS.

SAIC, N. West, B. Almeida, K.J. Scott. 1985. Rhode Island and Southeastern Massachusetts Dredging Needs Survey. Contribution #45, SAIC Report No. SAIC-84/7520&C45U.S. Army Corps of Engineers, NED. p 110 pp.

Abstract: Considerable concern has been expressed during the last several years by operators of water dependent businesses (ports and marinas) and environmentalists over the safe disposal of dredged material along coastal Rhode Island and Southeastern Massachusetts. Two previous reports, the RI Dredging Needs Survey (1980-1985) and the New England River Basins Commission Long Range Dredging Study (1981-1990) have suggested that there was a need for dredging operations in the southeastern New England region. The concern over the apparent need for dredging and the safe disposal of dredged materials was heightened by recent congressional interest and has raised the issue of the designation of a regional disposal site, either on land, in open water, or both.

To further define the need for a regional disposal site, it was deemed necessary to reassess the dredging needs on a regional basis. The objectives of this survey are the identification, classification, and projection of anticipated dredging needs for a ten year period from 1985-1995. This is part of a joint effort by EPA Region I and the New England Division of the Army Corps of Engineers. The results of this study will be incorporated into an EIS currently under development by EPA to facilitate the formal designation of a regional disposal site(s). The geographical study limits for this study are:
Western Limit - Rhode Island/Connecticut State Line
Eastern Limit - From RI/MA border east to outer Cape Cod area to Pleasant Bay (inclusive)

Islands - Martha's Vineyard, Nantucket Island and Block Island
Other - Cape Cod Canal from Buzzard's Bay to Sagamore Bridge

The study builds upon and extends the information and the area of the original study which the University of Rhode Island's Marine Advisory Service (URI, 1981) completed several years ago. This study has the following objectives:

1. Identification and projection of the magnitude of 1985-1995 dredging needs in Rhode Island and Southeastern Massachusetts coastal areas.
2. Identification of locations where this need is most pressing.
3. Identification of past (1981) perceived need for dredging and work actually accomplished between 1981 and the present in Rhode Island.
4. Identification of user group perceptions of quality of dredged materials and preferred means of disposal
5. Identification of perceptions of users related to
   (a) regulatory process,
   (b) impact on existing and future operations,
   (c) preferred means of disposal.

Saila, S.B., S.D. Pratt, and T.T. Polgar. 1971. Providence Harbor Improvement Spoil Disposal Site Evaluation Study: Phase II. Marine Experiment Station, University of Rhode Island. Kingston, RI.

Abstract: Between December 1967 and September 1972, 8.2 million cubic yards of dredge spoil from the Providence River were deposited on an offshore site in Rhode Island Sound. This marked the first time that dredge spoil from Narragansett Bay has been dumped offshore rather than within the estuary. This study is designed to bring physical observations of the dump site and material up to date, to examine aspects of dredge spoil dumping not explored in a previous study, and to reach general conclusions about the response of benthic invertebrates to environmental disturbances.

Sanders, H.L. 1969. Benthic Studies in Buzzards Bay: Animal-Sediment Relationships. Pages 149-169 In: Reish, D.J., (Ed.), Biology of the Oceans. Dickenson Publ. Co. Inc., Belmonth, CA.

Abstract: A quantitative benthic survey was undertaken in Buzzards Bay, Massachusetts, during October and November of 1955. Four survey stations (Fig 1: H, J. P, and R) were selected as being representative of different widespread sediment and faunal assemblages. They were subjected to intensive monthly sampling over a twelve-month period (February 1956-February 1957) with the purposes of measuring some of the dynamic properties of benthic communities such as growth, mortality, and organic turnover of the more important species components, of obtaining additional data on animal-sediment relationships, and of defining the niches of the numerically abundant species. This paper is concerned with animal-sediment relationships.

Santos, S.L. and J.L. Simon. 1980. Marine Soft-bottom Community Establishment Following Annual Defaunation: Larval or Adult Recruitment. Marine Ecology Progress Series. 2:235-241.

Abstract: Recolonization, following annual summer defaunation of a large-areal soft-bottom community in Hillsborough Bay, Tampa, Florida, USA was investigated to determine whether adult or larval recruitment was primarily responsible for re-establishing the community. Two quantitative sampling designs were employed: (1) Samples of the natural bottom were collected one month after each defaunation during 1975, 1976 and 1977, and washed through a 500 µm sieve; (2) containers of azoic sediment were placed and collected weekly during a 10-week period immediately following the 1978 defaunation, and washing through a 250 µm sieve. The weekly samples contained almost all newly settled larvae, (99.7%), while the monthly samples contained only 41% newly settled larvae. Whether the community was established by adult or larval settlement appeared to be taxon specific. Polychaetes and mollusks were mostly present as newly metamorphosed larvae. Amphipods, cumaceans and flatworms were initially present as adults. The discrepancies in the results stem from differences in methodologies of the two designs. The conclusion follows that methodologies must be tailored to the specific question posed, and that in this study, the majority of the initial community was established by larval than adult settlement.

Sardá, R. 1991. Macroinfaunal Populations of Polychaetes on a Salt Marsh in Southern New England. Bulletin of Marine Science. 48(2):594.

Abstract: Benthic macroinfaunal populations in Great Sippewissett Salt Marsh were monitored from Nov 1986 through Nov 1987. Three macroinfaunal environments based on particle size, organic matter and species composition were identified: sandy sediments, silty and sediments and muddy sediments. Sandy areas in the Marsh are characterized by the presence of Acanthausthorius millsi (Amphipod), Leitoscoloplos fragilis, Saccoglossus kowalevsky, Aricidea sp., Polygordius sp. and Streptosyllis sp. Silty sand areas in the Marsh had the highest values of biomass of the studied environments. This habitat is characterized by the presence of Marenzelleria viridis, Capitella capitata, Polydora ligni , Neanthes arenaceodentata, Neanthes succinea, Heteromastus filiformis , and one species of oligochaete. Muddy areas in the Marsh are basically colonized by a Streblospio benedicti population with a variable fauna associated through the year: Monopylephorus evertus, Paranais litorialis, Leptocheirus plumulosus, Nematostella vectensis, Manayunkai aesturina and some seasonal species like Dinophylus gardineiri and insect larvae.

Sardá, R. 1997. The Use of General Relationships to Estimate Secondary Production in Coastal Habitats: A Revision Based on a Case Study. Publicaciones Especiales - Instituto Espanol de Oceanografia. 23:11-22.

Abstract: Can general relationships developed to estimate secondary production be used to replace direct measurements without any previous calibration? A detailed study of seasonal dynamics and secondary production of benthic invertebrates in Great Sippewissett Marsh (southern New England, USA) provided data from which production rates were calculated, using direct measurements and classical methodologies (Hynes, 1961; Crisp, 1971). General relationships (Robertson, 1979; Banse and Mosher, 1980; Schwinghamer et al., 1986; Brey, 1990; Edgar, 1990; Morin and Bourassa, 1992; Benke, 1993) were then applied to estimate secondary production in order to test the accuracy of specific measurements. In the case of Great Sippewissett, the general relationships clearly underestimated the production values for the largest species (mean individual size greater than 1 mg dry weight), and overestimated the results for the smallest ones (mean individual size smaller than 1 mg dry weight). These relationships did not significantly improve production values when compared to values obtained by a rough methodology. The results of the present study indicate that a calibration of regression models against conventional methods is strongly recommended to check the ecological significance of the production values obtained. When possible, this should be done by establishing site-specific correlations between data obtained from both procedures.

Sardá, R., K. Foreman, and I. Valiela. 1995. Macroinfauna of a Southern New England Salt Marsh: Seasonal Dynamics and Production. Marine Biology. 121(3):431-445.

Abstract: The animal-habitat relationships and seasonal dynamics of the benthic macroinfauna were investigated from November 1986 to October 1988 in the Great Sippewissett Salt Marsh (Massachusetts, USA). Total macrofaunal abundance varied seasonally, displaying a peak in late spring and early summer, then declining sharply during late summer and recovering briefly in fall before collapsing in winter. Three macroinfaunal assemblages were found in the marsh, distributed along gradients of environmental factors. These included a sandy non-organic sediment assemblage, a sandy organic sediment assemblage and a muddy sediment assemblage. The species groups characteristic of unstable sandy non-organic sediments included the polychaetes Leitoscoloplos fragilis, Aricidea jefreyssi, Magelona rosea and Streptosyllis verrilli, the oligochaete Paranais litoralis, and the crustacean Acanthohaustorius millsi. Sandy organic sediments were characterized by the polychaetes Marenzelleria viridis, Capitella capitata, Neanthes succinea, N. arenaceodonta, Polydora ligni and Heteromastus filiformis, the oligochaete Lumbricillus, and the mollusc Gemma gemma. In muddy sites, the polychaete Streblospio benedicti and the oligochaetes Paranais litoralis and Monopylephorus evertus were the dominant species. Secondary production of benthic macroinfauna in each of these habitats was estimated. The highest values of biomass and production were recorded in the sandy organic sediments. Secondary production was estimated to be 1850 kJ/m super(2)/yr

in sandy organic areas, but only 281 kJ/m super(2)/yr in sandy non-organic areas and 113 kJ/m super(2)/yr in muddy areas. This results in an area-weighted average production of 505 kJ/m super(2)/yr for the unvegetated areas of the marsh. The Great Sippewissett Salt Marsh has an area of 483 800 m super(2).

Satchwill, R.J., L.A. Rinkle, C.L. Gray, and J. Temple. 1998. The Fisheries Resources of the Seekonk and Providence Rivers, Pawtucket, East Providence, Cranston, Warwick, and Barrington, Rhode Island. Performance Report. Project No. F-51-R-7. Rhode Island Division of Fish and Wildlife.

Savard, W.L. 1966. The Sediments of Block Island Sound. University of Rhode Island. Rhode Island.

Abstract: The bottom sediments of Block Island Sound were studied to determine their areal distribution, probable source areas, agents of transportation and conditions of deposition.

A total of 84 samples were collected and analyzed by sieving and hydrometer techniques and the statistical parameters for the grain size distribution were calculated on an IBM 1620 computer. Heavy minerals were identified using a petrographic microscope and the clay minerals were analyzed by X-ray diffraction.

Sand is the dominant textural class, covering most of the western and central parts of the Sound. The greatest concentration of silt and clay is on the submerged plain west of Block Island and in Napeague Bay. Sorting is mostly moderate to poor with well-sorted sand limited to the area around Cerberus Shoal in the southwestern part of the Sound.

Amphibole, black opaques and garnet make up approximately 60 per cent of the heavy minerals in each of a group of selected samples, while quartz makes up most of the light fraction. The clay component of five selected samples consisted solely of chlorite and illite.

The bottom sediments consist primarily of reworked subaqueous glacial deposits and unconsolidated glacial and post-glacial materials derived from adjoining shorelines. Their present distribution is due primarily to the tidal currents except in the western part of the Sound where some bathymetric lows act as sediment traps.

Scheltema, R.S. 1984. Development and Planktonic Larvae of Common Benthic Invertebrates of the Woods Hole, Massachusetts Region: Summary of Existing Data and Bibliographic Sources. Woods Hole Ocean.Tech. Rpt. WHOI-84-13 (CRC-84-2). Woods Hole Ocean. Inst. Woods Hole, MA. 43 pp.

Abstract: This report summarizes what is known about the early development of 380 of the most common invertebrate species found near Woods Hole, Massachusetts and gives bibliographic sources for the descriptions of 98 planktonic larval forms, including Gastropoda, Bivalvia, Decapoda, Stomatopoda, Cirripedia, Polychaeta, and Echinodermata. Many of the existing published descriptions of planktonic larvae are inadequate for their identification in samples taken from natural populations. Although the life-histories of less than one-half of the most common benthic invertebrates from the region of Woods Hole are presently known, such data are important for both ecological studies and for understanding the dynamics of benthic communities.

Schevill, W.E., K.E. Moore, and W.A. Watkins. 1981. Right Whale, Eubalaena Glacialis, Sightings in Cape Cod Waters. Technical Report Prepared for the Office of Naval Research under Contract N0014-79-C-0071. Woods Hole Oceanographic Institution. Woods Hole, Massachusetts. 16.

Schevill, W.E., W.A. Watkins, and K.E. Moore. 1986. Status of *Eubalaena glacialis* off Cape Cod. Pages 79-82 Brownell, R.L., Jr., P.B. Best, and J.H. Prescott, (Eds.), Right Whales: Past and Present Status - Proceedings of the Workshop on the Status of Right Whales., Cambridge.

Abstract: Historic and recent records of abundance and distribution of *Eubalaena glacialis* near Cape Cod are scanty and imprecise, and cannot be considered a census. The historical records since 1620 and ours

from 1955 to 1981 both show a seasonal peak in April and few sightings in summer months. During the last quarter century our counts show up to 131 individuals in one year; 70+ were the most seen in one day. We have seen 21 calves, up to 4 in one year, with an indication of a 3-year reproductive cycle. Individual whales usually remain in the area only a few days at a time. The evidence available does not demonstrate that *E. glacialis* in our waters nowadays are really very much fewer than they were in 1620. Our sightings off Massachusetts since 1955 show neither an increase nor a decrease in right whales.

Schwartz, J.P. 1988. Distribution and Concentration of Polychlorinated Biphenyls in Lobster, Winter Flounder, and Quahogs from Buzzards Bay, Massachusetts. Draft Report to Buzzards Bay Project, Massachusetts Division of Marine Fisheries, Cat Cove Marine Lab, Salem, MA. 27 pp.

Science Applications International Corporation. 1987. Buzzards Bay REMOTS Survey, New Bedford to Station "R" transect. Draft Report to Buzzards Bay Project. Page 18 pp.

Science Applications International Corporation. 1990. Preliminary Field Operations in Support of Disposal Site Designation in the Rhode Island Sound Region: Submitted to: Regulatory Branch, New England Division, U.S. Army Corps of Engineers. U.S. Army Corps of Engineers, New England Division. Waltham, MA.

Sears, J.R. and R.T. Wilce. 1975. Sublittoral, Benthic Marine Algae of Southern Cape Cod and Adjacent Islands: Seasonal Periodicity, Associations, Diversity, and Floristic Composition. Ecological Monographs. 45(4):337-365.

Abstract: The periodicity, associations, species diversity, and composition of the sublittoral, attached algal vegetation were studied at four ecologically distinct stations in southern Cape Cod and adjacent islands. In situ collections and observations of 142 species of attached sublittoral algae (Chlorophyta, Phaecophyta, and Rhodophyta) were made with the aid of diving equipment. These were categorized into four groups with respect to seasonal periodicity (seasonal annuals, aseasonal annuals, pseudoperennials, and perennials) based on thallus longevity, plant form during their adverse season, and the period in which each species population was present in the community. Using these criteria we recognize the influence of environmental change on algal development, and the plants' temporal influence on the community.

Based on qualitative and quantitative sampling, 10 sublittoral algal associations have been recognized from 2 bottom substrata types.

The distribution of sublittoral attached algae at our four stations was more complex than can be accounted for by the three sublittoral algal associations as described in studies of other geographic areas. This may be due to the different levels at which associates have been recognized, to the type and degree of substratum stability, and to whether consideration is given to algal seasonal periodicity. The concept of a universal tripartite zonation of sublittoral algae is unacceptable when these factors are considered in vegetational analyses.

An in-habitat, seasonal comparison of species diversity and composition was based on adjacent quantitative collections from a uniform shell bottom at 6 and 12 m. Species diversity remained seasonally stable at these depths; species composition, however, changed dramatically throughout the year. At 6 m, brown algae dominated in winter and were replaced by red algae during summer. At 12 m, the seasonal floristic changes were less pronounced, and red algae dominated year-round.

A between-habitat comparison of species numbers and composition was based on year-round qualitative collections and observations made at four regularly visited stations (5–22 m depth). Species numbers decreased with increased station depth from 5 to 22 m except for one heavily silted station. The seasonal change of floristic composition was most striking at West Chop (5–8 m) where short- and long-lived species were about equally represented. Seasonal differences in species composition between summer and winter were striking at a 5–8 m station but were less pronounced with increased station depth where long-

lived spices made up an increasingly larger percentage of the total vegetation. Floristic composition also differed among stations. About equal numbers of red and brown species occurred at 5–8 m in contrast to the occurrence of about 4 times more red than brown species at 22 m. The crust vegetation also made up an increasingly larger percentage of the deep vegetation when compared with the vegetation of shallower areas sampled.

Species diversity at 20–22 m was much higher in southern Cape Cod than reported for similar depths to the north (Cape Ann, Massachusetts; New Hampshire; Halifax, Nova Scotia); this may be due in part to the intensive collecting of crustose forms during the present study.

Seawifs-gfsc. 1992. "Ocean Planet: Perils-Overfishing Commercially Important Fish". http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/peril_overfishing.html.

Abstract: This website (http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/peril_overfishing.html) lists the status of several commercially caught fish species based on 1992 data from the United Nations Food and Agriculture Organization. Fish included on the website are Atlantic Cod, Haddock, Bluefin Tuna, Atlantic Mackerel, and Silver Hake, among others.

Sedgwick, S., C. Collins, and S. Olsen. 1980. Commercial Fishing Facilities Needs in Rhode Island. University of Rhode Island Coastal Resources Center. [Kingston, R.I.].

Abstract: We conclude that there is a need for a renewed commitment to Rhode Island's fishing industry because of the high level of economic activity generated by commercial fisheries, their dependence on a renewable and native resource, and the vigor and expansion the industry has shown since the early 1950s. The principal goal of state action should be to foster growth in fleets home-ported in Rhode Island since this will generate the most economic activity and employment. To achieve this goal the state should continue its efforts to upgrade facilities at Galilee, expand berthing facilities leased by the state at Newport and establish a new fishing port at an excessed Navy property now owned by the state. Although the Coddington Cove boat basin is the optimal site for a new port it is being retained by the Navy. This makes Melville the best available site for development of a new fishing port. Efforts at Galilee, Newport and Melville should proceed concurrently. An increased state commitment to fisheries coupled with the fast pace of change in the industry also leads us to conclude that communications among all those involved in fisheries must be improved.

Sheih, M.S.J. 1974. Nutrients in Narragansett Bay Sediments. URI.

Abstract: A knowledge of nutrient concentration levels in the sediments, using nutrient profile as an indicator of pollution, can be a revealing and important factor in defining the water quality of the Bay. The intent of this study was to examine the nutrient distribution of nitrogen and phosphorus in sediment cores of Narragansett Bay. The findings would serve to indicate the effect of man's activities on the rate of estuarine eutrophication and to interpret the pollution history of the Bay.

Results obtained indicate that the sediments have a greater probability of concentrating pollutants and therefore, are better used to indicate some types of bay pollution than analyses of the overlying water. It was found in the analyses of core sections in each station that total nitrogen and total phosphorus increase rapidly in the upper 4-inch section. From this result we postulate that the Bay water was fertilized by man during the past two centuries. The available nitrogen and phosphorous concentration levels increase with greater depth. Consequently, we can expect the sediment dredging to such depth will make the newly exposed sediment nutrients more available for algae growth. Therefore, on the basis of available nitrogen and phosphorous, sediment dredging gives no beneficial but ill effect on the Bay water. The best way to protect the water quality of the Bay is to reduce the rate of nutrient input, especially phosphorous, to the estuary.

With the relative amount of nutrient in the sediment of stations sampled, we can divide the Bay into three environments: polluted district--including Stations Y, Y.Y., and Z; lightly polluted district--including Stations L and H; nonpolluted district--including Stations G and B.

The presence and amounts of chemical substances such as organic carbon, iron and manganese, especially iron, associate with the nutrient deposition well, and thus can be correlated in the interpretation of the deposition mechanisms. The ratio of N:P was low compared with other reports. It showed that the eutrophication potential of the Bay is likely dependent on nitrogen. However, since some blue-green algae can fix the nitrogen gas from the atmosphere from which it is not easy to control, a reduction in the rate of P input to minimize the phosphorus contribution to the estuary in order to control the algal nuisances is necessary for recreational use and increasing shoreline real estate value.

Shepherd, G.R. and M. Terceiro. 1994. The Summer Flounder, Scup, and Black Sea Bass Fishery of the Middle Atlantic Bight and Southern New England Waters. NOAA Tech. Rep. NMFS 122. U.S. Department of Commerce. 13 pp.

Abstract: Summer flounder, Paralichthys dentatus, scup, Stenotomus chrysops, and black sea bass, Centropristis striata, occur within the Middle Atlantic Bight and off southern New England and are important components of commercial and recreational fisheries. The commercial otter trawl fishery for these species is primarily a winter fishery, whereas the recreational fishery takes place between late spring and autumn. The otter trawl fishery generally targets summer flounder, and less frequently scup, while black sea bass occurs as bycatch. Trips in which all three species were present yielded highest aggregate landings per unit of effort (LPUE) levels and occurred more often than trips landing only one or two species. More than 50% of the trips in the trawl fishery landed at least two of the three species. In contrast, greater than 75% of the recreational landings of each species occurred as a result of trips landing only one species. Differences in the fisheries resulted from the interactions of seasonal changes in species distributions and gear selectivity (DBO).

Sherman, K., N. Jaworski, and T. Smayda. 1992. Summary of the Symposium on the Northeast U.S. Shelf Ecosystem: Stress, Mitigation, and Sustainability. Held in Narragansett, Rhode Island on August 12-15, 1991. NOAA-TM-NMFS-F/NEC-94. 29p.

Abstract: A symposium on the Northeast U.S. Shelf Ecosystem, extending from the Gulf of Maine to Cape Hatteras, North Carolina, was held on the Bay Campus of the University of Rhode Island's Graduate School of Oceanography during 12-15 August 1991. The objective of the symposium was to bring pertinent science to aid in the mitigation of severe stress imposed on the sustainability of the Northeast U.S. Shelf Ecosystem and its wetlands, estuaries, coastal zone, fisheries, marine mammals, and other resources.

Shimeta, J. and J.D. Sisson. 1999. Taxon-specific Tidal Resuspension of Protists into the Subtidal Benthic Boundary Layer of a Coastal Embayment. Marine Ecology Progress Series. 177:51-62.

Abstract: Sediment resuspension has widespread effects on microbial processes, primary and secondary production, and nutrient cycles, but its influence on protests other than microalgae is largely unknown. Distributions and abundances of protests in subtidal benthic boundary layers (BBL), in particular, are poorly known. We measured vertical profiles of protests in the BBL and underlying sediment at a subtidal silty site in Buzzards Bay, Massachusetts, USA, to determine cell-resuspension patterns. Tidal flow produced maximal bottom shear velocities of 1.4 to 2.2 cm s . Near-bottom turbidity increased during each slack tide, when the suspended load settled, and it decreased during tidal exchange, presumably after a thin veneer of sediment resuspended from the sediment-water interface (SWI) and mixed into the upper water column. Tidal periodicities in protistan vertical profiles were taxon- and functional-group specific. Heterotrophic nanoflagellates (Hnan) and ciliates, including scuticociliates, oligotrichs, and hypotrics of the genera Euplotes and Urostrongylum, showed periodicities in distribution consistent with cycles of resuspension and deposition. BBL concentrations of HNan and scuticociliates were elevated during tidal exchange by factors of < 2.1 and 4.6, respectively, within 5 cm of the SWI; oligotrichs were found consistently in the BBL but were in the sediment only during slack tide; Euplotes

was present consistently in the sediment but was in the BBL only during tidal exchange. Total resuspended cells in the bottom 1 m were of the order 10 to 10 Hnan m-2 and 10 to 10 ciliates m 2, and in some case the measured cell disappearance from surficial sediment during tidal exchange balanced the increase in the BBL. In contrast, pigmented nanoflagellates, pinnate diatoms, and ciliates, including karyorelictids and other hypotrichs, maintained constant profiles throughout tidal cycles. Specificity of results among protistan groups might be due to behavioral adaptations such as depth zonation in the sediment, associations with particles, and vertical migration. We know of no other documentation in the field of cyclical emergence of heterotrophic protests and re-entry into sediment. Our data suggest complex taxon-specific linkages between sedimentary and water-column protistan communities that may be controlled by flow in the BBL, potentially influencing food-web dynamics.

Shimeta, J., V.R. Starczak, and O.M. Ashiru. 2001. Influences of Benthic Boundary-layer Flow on Feeding Rates of Ciliates and Flagellates at the Sediment-Water Interface. Limnology and Oceanography. 46(7):1709–1719.

Abstract: We investigated whether boundary-layer flow strength influences feeding rates of benthic protists by measuring ingestion rates of bacterivorous ciliates and flagellates at the sediment-water interface of a flume. Feeding rates were measured by the uptake of fluorescently labeled bacteria during short-term incubations, thus isolating the effects of flow on feeding mechanics and behavior from longer-term effects such as physiological responses and population growth. Measurements at the sediment-water interface were facilitated by adding cultured protists to a thin layer of cleaned sediment with manipulated bacterial concentrations, thereby preventing a subsurface refuge from flow and allowing control of the type and distribution of food resources. Four species of benthic suspension-feeding ciliates were tested in this fashion, including several scuticociliates and a hypotrich, which are common taxa in fine sediments (Fenchel 1987; Shimeta and Sisson 1999; Garstecki et al. 2000). To corroborate the results, separate experiments were run with freshly collected sediment cores to measure feeding by uncultivated protists in natural positions within unaltered sediment, as well as to look for community-level effects of flow on natural assemblages of ciliates and nanoflagellates. Flow data from the field site were used to extrapolate the laboratory results to predict the effects of tidal flow on feeding rates in nature.

Sholkovitz, E.R., D.J. Piepgras, and S.B. Jacobsen. 1989. The Pore Water Chemistry of Rare Earth Elements in Buzzards Bay Sediments. Geochim. Cosmochim. Acta. 53(11):2847-2856.

Simpson, E.J. 1977. A Photogrammetric Survey of Backbarrier Accretion on the Rhode Island Barrier Beaches. URI.

Abstract: Washover fans and tidal deltas are known to be significant sediment storage sites on the barrier islands of the Outer Banks of North Carolina and the Texas Gulf Coast. No previous studies, however, have attempted to quantify the importance of these sediment sinks in the littoral sediment budget.

The relative importance of washover and tidal delta sedimentation on the erosional shoreline of Rhode Island has been determined from a photogrammetric analysis of the backbarrier shoreline changes on the south shore barrier beaches from Napatree Point to Point Judith over the period of 1939 to 1975 (the dates of the earliest and latest aerial photographic coverage). Amounts of areal changes were measured directly or were calculated from direct measurements. Determination of volumetric changes required additional information concerning annual rates of vertical washover sedimentation (0.03-0.04 m/yr, from Godfrey, 1976; and 0.05 m/yr, this study) and an estimate of volumetric change per areal change of eroded beach from the U. S. Army, Coastal Engineering Research Center (1973) in which a change of 0.09 m^2 along the shoreline is equivalent to a volumetric change of 0.76 m^3, or a change of 8.44 m^3/m^2.

Backbarrier areas were measured using a square grid point-counting technique. These direct areal measurements were converted to ground areas using the representative fractional scales determined for each individual photograph from ground truth measurements, and the amounts of areal changes of supratidal and subtidal washover and tidal delta deposits and of eroded beach were calculated for the period of 1939 to 1975. Total areal change of supratidal plus subtidal washover deposits was +522,792 + 267,953

m^2 = +790,745 m^2; total areal change of supratidal plus subtidal tidal delta deposits was +188,238 + 862,322 m^2 = +1,050,560 m^2. Total area of eroded beach for the whole south shore was -608,558 m^2. Annual rate of areal changes of washover deposits for the whole south shore was calculated to be +21,965 m^2/yr; for annual tidal delta accretion, +29,182 m^2/yr; and for annual rate of beach erosion, -16,904 m^2/yr.

According to these values of areal changes, subtidal plus supratidal tidal delta sedimentation is $1^1/_3$ times more effective than subtidal plus supratidal washover sedimentation in the landward transportation, deposition, and storage of sediment. Supratidal washover accretion, however, is nearly three times more effective than supratidal delta accretion.

Using the derived annual rate of vertical washover sedimentation of 0.05 m/yr to compute the approximate volumetric values of changes for both washover and tidal delta deposits (in the absence of any indication of vertical tidal delta accretion rates), and using the Coastal Engineering Research Center's value of 8.44 m^3 sediment loss (or gain) per 1 m^2 areal units of beach erosion (or accretion) to compute the volume of eroded beach, the following results were obtained. Washover accretion was determined to be +1,354,809 m^3 for the whole south shore over the entire study period, tidal delta accretion is +1,822,476 m^3, and the amount of eroded beach is -5,138,934 m^3. According to these values, overwash can account for 26% of the sediment eroded from the beaches and tidal delta sedimentation for 35%. Losses to alongshore and offshore transport of sediment therefore total 39% of the volume of sediment eroded from the beaches of the south shore of Rhode Island.

The greatest factor controlling the occurrence and amount of washover accretion appears to be an erosional beach. At 27% of the transects at which washover accretion was significant (*i.e.*, more than the mean value of +18,000 m^2), beach erosion was also significant (*i.e.*, less than the mean value of -6,000 m^2). At 66% of the transects at which washover accretion was significant to moderate (*i.e.*, greater than +18,000 m^2 or greater than 0 and less than +18,000 m^2), beach erosion was also significant to moderate (*i.e.*, less than -6,000 m^2 or greater than -6,000 m^2 but still less than 0). Other related controlling factors are the height and continuity of the dunes, the development of transitory inlets, and the width of the barrier beach (which is a function of the development of tidal deltas and washover backbarrier deposits and of the amount of beach erosion).

Sissenwine, M.P. and S.B. Saila. 1974. Rhode Island Sound Dredge Spoil Disposal and Trends in the Floating Trap Fishery. Volume 103.

Abstract: The available data was evaluated to assess the impact of the Rhode Island Sound dredge spoil disposal area on the floating trap fishery. It is unlikely that a significant portion of the observed decline in landings has resulted from a decrease in fishing effort since no significant correlation was established between these variables. The mean levels of landings were not significantly different when comparisons were made between the period before the onset of dumping and the short post-dumping period. A review of other fisheries for scup, the predominant species caught by Rhode Island floating traps, indicated that landings have declined throughout the species' range.

Smith, F.E. 1950. The Benthos of Block Island Sound: I. The Invertebrates, their Quantities and their Relations to the Fishes [Microfilm].

Abstract: The bottom fauna of fishery grounds in Block Island Sound has been studies, with emphasis on the relation of the fauna to the fishery. Previous work consists of faunal lists. A review is given of quantitative analyses of bottom faunas for other regions, particularly of those studies from the Danish and Plymouth laboratories.

For the present study, bottom material was collected with a 2-foot Agassiz dredge. Odometers on the dredge provided quantitative estimates. Fish data were collected on a commercial trawler. Stomach analyses were made from samples of all fish species taken in each haul.

Quantitative estimates of the standing crops of invertebrates are treated in classical manner. The dredge, by itself, is not an adequate sample, the average estimate of 9.5 gm./sq.m. of bottom invertebrates (wet weight) is probably low.

Stomach analyses are treated in a new and comprehensive manner. The annual consumption of bottom invertebrates by catchable fish (all species) is estimated to be 19.6 gm./sq.q/ of bottom. Of this food, 90% is crustacean, 60% is amphipodan, and 46% is one species of amphipod, *Leptocheirus pinguis*.

All bottom fishes eat *L. pinguis* to some degree. Much information on both the fishes and the amphipod is gained from analyses of the proportions of males to adults of *L. pinguis* eaten by each fish species from each net haul. Similar analyses are made for the proportions of brooding females to the total bulk of *L. pinguis* eaten. Hypotheses of behavior are advanced for the 8 statistically significant relations that were found.

Twenty-eight other bottom invertebrates are eaten to a measurable degree by fishes. The amount of each eaten by each fish species is calculated. Observational notes, including behavior in aquaria, are given for the food species. Analyses of the fish diets, combined with knowledge of the habits of the food species, corroborates the hypotheses reached on the feeding behavior of the fishes from the analyses of *L. Pinguis*. Each major fish has a distinct and definable feeding pattern such that the several fish niches overlap but do not coincide.

The ecological system of 8 predators (fishes) and 29 prey (invertebrates) is analyzed to define in a quantified manner the position of each species in the system. The analysis provides a method for relating each species to the rest of the system as a whole, as well as for comparing any two species within the system. It depends only upon field data, and can be applied generally.

From calculated sampling errors of the data, a design for future experiments is constructed so that labor would be spend efficiently. In the present study, the samples of fish taken for stomach analyses should have been larger.

Smith, J.D. 1969. Geomorphology of a sand ridge. J. Geol. 77:39-55.

Smith, J.W. 1999. Distribution of Atlantic Menhaden, *Brevoortia tyrannus*, Purse-seine Sets and Catches from Southern New England to North Carolina, 1985-96. NOAA Technical Report NMFS 144. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Scientific Publications Office. Seattle, WA. 22p.

Abstract: Sets and catches of Atlantic menhaden, Brevoortia tyrannus, made in 1985-96 by purse-seine vessels from Virginia and North Carolina were studied by digitizing and analyzing Captain's Daily Fishing Reports (CDFR's), daily logs of fishing activities completed by captains of menhaden vessels. 33,674 CDFR's were processed, representing 125,858 purse-seine sets. On average, the fleet made 10,488 sets annually. Virginia vessels made at least one purse seine set on 67%-83% of available fishing days between May and December. In most years, five was the median number of sets attempted each fishing day. Mean set duration ranged from 34 to 43 minutes, and median catch per set ranged from 15 to 30 metric tons (t). Spotter aircraft assisted in over 83% of sets overall. Average annual catch in Chesapeake Bay (149,500 t) surpassed all other fishing areas, and accounted for 52% of the fleet's catch. Annual catch from North Carolina waters (49,100 t) ranked a distant second. Fishing activity in ocean waters clustered off the Mid-Atlantic States in June-September, and off North Carolina in November-January. Delaware Bay and the New Jersey coast were important alternate fishing grounds during summer. Across all ocean fishing areas, most sets and catch occurred within 3 mi. of shore, but in Chesapeake Bay about half of all fishing activity occurred farther offshore. In Virginia, areas adjacent to fish factories tended to be heavily fished. Recent regulatory initiatives in various coastal states threaten the Atlantic menhaden fleet's access to traditional nearshore fishing grounds.

Smith, R. 1993. Management of Marine Fisheries through the Rhode Island Marine Fisheries Council. P1328. Pages 23-27 In: Rice, M.A. and D. Grossman-Garber. Proceedings of the Second Rhode Island Shellfish Industry Conference. Narragansett, RI, August 4, 1992. Rhode Island Sea Grant. Narragansett, RI.

Abstract: The Rhode Island Marine Fisheries Council (RIMFC) is responsible for the promulgation of rules and regulations for the management of capture fisheries in the waters of the state of Rhode Island. Several examples of fishery management issues from RIMFC and the New England Regional Fisheries Council are discussed, including offshore groundfish, striped bass, winter flounder and quahog fisheries. Successful management of fisheries stocks relies heavily on developing appropriate regulations with the cooperation of both the commercial and recreational fishing communities. Cooperation and negotiation between groups is an important ingredient of success.

Smith, R.M. and C.F. Cole. 1973. Effects of Egg Concentrations of DDT and Dieldrin on Development in Winter Flounder (*Pseudopleuronectes americanus*). Journal of the Fisheries Research Board of Canada. 30(12-1):1894-1898.

Abstract: Abnormal gastrulation and a high incidence (mean = 39%) of vertebral deformities at hatching were encountered in developing eggs from winter flounder, Pseudopleuronectes americanus, experimentally exposed as adults to sublethal concentrations of DDT. Bone erosion and hemorrhaging at the vertebral junctures were often observed in conjunction with the vertebral deformities. No abnormal gastrulation and a lower incidence (mean <1%) of vertebral deformities without bone erosion and hemorrhaging were encountered in controls. DDT concentrations in the eggs ranged from 0.39 to 4.60 (mean = 2.42 pp,) compared to 0.110.57 ppm (mean = 0.22 ppm) in the eggs from control flounder. No observable effect on development was noted in eggs from adults exposed experimentally only to dieldrin except in two lots of eggs most of which were dead and necrotic at spawning and contained 1.74 and 1.21 ppm dieldrin. No direct effect on fertilization mortality was due to gamete concentrations of DDT and dieldrin and no residues of either insecticide wee detected in the milt from exposed or control male flounder.

Snelgrove, P.V. 1993. Importance of Fine-Scale Flow Processes and Food Availability in the Maintenance of Soft-Sediment Communities. Doctoral Thesis. WHOI-93-27. Woods Hole Oceanographic Institution. Woods Hole, MA. 484 pp.

Abstract: To test whether near-bed hydrodynamics modify larval settlement, field and flume experiments were conducted where larval settlement was compared between microdepositional environments (small depressions) and non-trapping environments (flush treatments). Flume flow simulations with the polychaete Capitella sp. I and the bivalve Mulinia lateralis demonstrated that although larvae of both species were generally able to actively select a high-organic sediment over a low-organic alternative with a comparable grain size, elevated densities of both species were observed in depressions for a given sediment treatment. In field experiments carried out in Buzzards Bay, Massachusetts, significantly higher densities of Mediomastus ambiseta juveniles, spionid polychaete juveniles, bivalves, gastropod larvae, and nemerteans were observed in depressions compared with flush treatments over 5 experimental periods (3-4 days each) during the summer of 1990, suggesting that larvae were passively entrained in depressions. These experiments suggest that near-bed hydrodynamics may modify settlement at some scales, and that both active and passive processes may determine larval distributions in shallow-water, muddy habitats. In a deep-sea habitat near St. Croix, densities of colonizers in flush treatments were generally higher than in comparable depression treatments, suggesting that passive entrainment did not occur and habitat selection was highly active.

Snooks, J.H. and J.P. Jacobson. 1979. Currents and Residual Drift in Block Island Sound during the Period February through December 1977. Yankee Atomic Electric Company, Environmental Sciences Group. Westborough, MA.

Snooks, J.H. and W.P. Kramer. 1979. Summary of Temperature and Salinity Observations in Block Island Sound during July 1975 through September 1976. Yankee Atomic Electric Company. Westborough, MA.

> **Abstract:** Bi-weekly salinity, temperature, depth (STD) observations at twelve stations in a 3 by 4 mile area of Block Island Sound off the southern Rhode Island coast during a fifteen month period revealed a well defined vertical and horizontal structure. Temperatures exhibited an annual cycle; a thermocline, present from late May through August, had maximum gradients (surface to bottom difference) ranging from 8–12°F. Salinity did not display a well-defined annual cycle and was instead, affected by fresh water runoff. Vertical salinity gradients were usually small (0.5 ‰). Density generally reflected the annual temperature regime, but on several occasions of high fresh water runoff, was a reflection of the resultant low salinity regime. A horizontal STD isopleth pattern was prominent during summer; a vertical pattern occurred during winter.
>
> The seasonal variability of salinity and temperature at individual measurement stations and between stations was very small and no statistical difference could be determined. Hence, one water mass (coastal Block Island Sound water), made up from low salinity coastal fresh water drainage and higher salinity offshore continental shelf bottom water, was present throughout the study period.

Snow, W.B., H.B. Hoff, and J.J. Markham. 1944. Transmission Survey of Block Island Sound. U.S. Underwater Sound Laboratory, Division of War Research. New London, CT.

> **Abstract:** The placement of sonic detection equipment for optimum response requires the knowledge of background noise levels and the transmission characteristics of the water. The present report describes the methods and results of surveys conducted in Block Island Sound in the vicinity of Fishers Island and Block Island. The survey included both acoustical and oceanographic measurements. The acoustical data consisted of background noise and transmission loss measurements. Various conclusions, some of which should be the subject of further study, are presented herein.

Sogard, S.M., K.W. Able, and M.P. Fahay. 1992. Early Life History of the Tautog *Tautoga onitis* in the Mid-Atlantic Bight. Fishery Bulletin. 90(3):529-539.

> **Abstract:** Spawning patterns, larval distribution, and juvenile growth characteristics were examined for tautog Tautoga onitis in New Jersey and the Mid-Atlantic Bight. We analyzed data from plankton surveys (1972-1990) over the continental shelf and in the Great Bay-Mullica River estuarine system. Data on size and abundance of juveniles were derived from throw trap and trawl collections in New Jersey estuaries (1988-89). In addition, we validated the daily deposition of otolith increments and used increment counts to estimate juvenile age and growth patterns. Extensive egg and larval collections indicated that spawning occurs from April through September, with a peak in June and July. Spawning over the continental shelf is concentrated off Long Island and Rhode Island. Based on validated daily increments in sagittal otoliths and the formation of a well-defined settlement mark, tautog larvae spend about 3 weeks in the plankton. Both spawning and settlement occur over a prolonged period, based on otolith back-calculations. Three methods of estimating young-of-the-year growth rates, including length-frequency progressions, otolith age/fish-size comparisons, and direct measurement of growth in caging experiments, indicated an average growth rate of about 0.5 mm/day during the peak midsummer growing season. Length-frequency distributions suggested tautog reach a modal size of about 75 mm SL after their first summer, and 155 mm by the end of their second summer.

Sorensen, P.W., R.J. Medved, M.A.M. Hyman, and H.E. Winn. 1984. Distribution and abundance of cetaceans in the vicinity of human activities along the continental shelf of the northwestern Atlantic. Marine Environmental Research. 12:69-81.

Abstract: The distribution and abundance of cetaceans were investigated in the vicinity of oil rigs, surface oil and boat traffic along the continental shelf of the northwestern Atlantic. Data concerning the total number of cetacean sightings and individuals were obtained from dedicated aerial surveys conducted between January 1979 and January 1982. Sightings per unit effort and individuals per unit effort for areas surrounding active oil rigs were not significantly different from those found in the same areas when no oil rigs were present. Surface oil was sighted ninety-four times. Cetacean sightings were made in the vicinity of oil on eleven different occasions and in oil twice. None of these animals was noted as displaying unusual behavior and no feeding was observed. The presence of boat traffic was found to decrease the probability of sighting squid-eating cetaceans but had no apparent effect on the probability of sighting fish-eating cetaceans.

Sparsis, M., J.T. Dealteris, and M.A. Rice. 1993. Effects of Bottom Cultivation on Quahogs and Other Bottom Invertebrates in Narragansett Bay. Pages 63-78 In: Rice, M.A. and D. Grossman-Garber. (Eds.), Proceedings of the Second Rhode Island Shellfish Industry Conference, Narragansett, Rhode Island, August 4, 1992. Rhode Island Sea Grant Report. Narragansett, Rhode Island.

Abstract: The effects of mechanical disturbance of estuarine sediments on the population structure of quahogs and other infauna was studied. Nine contiguous circular study plots with a 10 m radius were established in approximately 3.5 m of water in the West Passage of Narragansett Bay. Preliminary sediment and infaunal samples were taken as a baseline. The infaunal assemblages were typical of the West Passage. Numerically dominant species were nematodes, capitellids, spionids, oligochaetes, and the amphipod Ampelisca abdita. Quahogs, Mercenaria mercenaria, were in low abundance (3.6 animals/m super(2)) and averaged 85 mm in valve length. After preliminary sampling, three plots were harvested using a hydraulic bullrake, an additional three plots were cultivated (sham harvested using the hydraulic bullrake with an open basket to leave quahogs on the bottom), and three plots were left untreated as control areas. The thorough, one-time sediment disturbance did not significantly alter sediment grain-size characteristics, TOC, or water content. No statistically significant differences in infaunal communities were noted after the hydraulic disturbance. The magnitude of effects of bottom cultivation were much less than natural spatial and seasonal variability in the study plots.

Stanley, J.G. and R. DeWitt. 1983. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates-Hard Clam. USFWS Biological Report FWS/OBS-82/11.18. U.S. Fish and Wildlife Service. 19 pp.

Steimle, F.W. 1982. The Benthic Macroinvertebrates of Block Island Sound. Estuarine Coastal and Shelf Science. 15: 1-6.

Steimle, F.W. and C. Zetlin. 2000. Reef Habitats in the Middle Atlantic Bight: Abundance, Distribution, Associated Biological Communities, and Fishery Resource Use. Marine Fisheries Review. 62(2):24-42.

Abstract: One particular habitat type in the Middle Atlantic Bight is not well recognized among fishery scientists and managers, although it is well known and used by recreational and commercial fisheries. This habitat consists of a variety of hard-surface, elevated relief "reef" or reef-like environments that are widely distributed across the predominantly flat or undulating, sandy areas of the Bight and include both natural rocky areas and man-made structures, *e.g.* shipwrecks and artificial reefs. Although there are natural rock and shellfish reefs in southern New England coastal waters and estuaries throughout the Bight, most reef habitats in the region appear to be man-made, mostly wrecks and "obstructions," and man-made reef habitat modification/creation may be increasing. Very little effort has been devoted to the study of this habitat's distribution, abundance, use by living marine resources and associated biological communities (except on estuarine oyster reefs), and fishery value or management. This poorly studied and surveyed

habitat can provide fish refuge from trawls and can be a factor in studies of the distribution and abundance of a variety of reef-associated fishery resources. This review provides a preliminary summary of information found on relative distribution and abundance of reef habitat in the Bight, the living marine resources and biological communities that commonly use it, threats to this habitat and its biological resources, and the value or potential value of artificial reefs to fishery or habitat managers. The purpose of the review is to initiate an awareness among resource managers about this habitat, its role in resource management, and the need for research.

Stenner, T.W., T.C. Gulbransen, and E.M. Baptiste. 1988. Water Quality Data Assessment for Buzzards Bay: Coliform and Nutrients. Buzzards Bay Project Report. Battelle Ocean Sciences. Duxbury, MA. 69 pp + appendices.

Abstract: In 1985, The Buzzards Bay Project, managed by the Commonwealth of Massachusetts Executive Office of Environmental Affairs and the U.S. EPA, Region I, began an effort to characterize the health of the Buzzards Bay estuary, located in southeastern Massachusetts and west of Cape Cod. As part of this program, historical data sets were collected by several investigators for the following topics: water quality and nutrients, coliform bacteria, toxic substances in organisms and sediments, lobster landings; shellfish landings; and finfish resources.

The purpose of this project was to review historical data, available in the EPA database management system, on coliform bacteria and nutrients in Buzzards Bay. This review included identifying relevant parameters for characterization; assessing, where possible, the utility of methods used in generating the data sets, and characterizing where possible, coliform bacteria and nutrients over time and space in Buzzards Bay. This report is intended to be an assessment of nutrient and coliform data and is to be used in drafting future management recommendations for Buzzards Bay; as such, the report will contribute to the summary of the Bay's past, present and future water quality conditions as well as to the Comprehensive Conservation and Management Plan for the estuary.

Stevens, J., M. Pilaro, and D. Geagan. 1997. The Greenwich Bay Initiative: A Case Study of Shellfish Habitat Restoration through Land Use Planning. Journal of Shellfish Research. 16(1):275.

Abstract: In December 1992, the Rhode Island Department of Environmental Management closed Greenwich Bay's 1,280 acres of highly productive shellfish beds due to dangerously high levels of fecal coliform bacterial pollution. Economically, Greenwich Bay previously accounted for up to 90 percent of the state's winter hardshell clam harvest. Locally, the Warwick shellfishing industry generates $4-6 million annually and employs over 500 individuals. In response to this environmental and economic disaster, the Warwick mayor directed several city departments to prepare a strategic plan for the unconditional re-opening of Greenwich Bay to shellfishing. Thus, the “Greenwich Bay Initiative” was established, evolving into a non-partisan association of federal, state, and local government agencies, as well as non-profit environmental organizations and private agencies, combining to work cooperatively to restore Greenwich Bay's health. The ultimate challenge is to revitalize Rhode Island's beleaguered shellfishing industry and restore the health of the marine environment. The Greenwich Bay Initiative is carried out through cooperative efforts in four focus areas: coordination, research, remediation, and education outreach. Some of the Initiative's accomplishments include: computer monitoring of pollution levels in the Bay; high-tech GIS mapping and digital orthophotography to identify pollution sources; free sewer connections for low-to-moderate income families; installation of innovative and alternative on-site wastewater technology; installation of best management practices to reduce pollution from stormwater runoff; installation of eight pump out facilities at Warwick marinas; and watershed training in wise land use practices for municipal board and commission members. The Greenwich Bay Initiative represents public/private partnership at its best. By working cooperatively, the local governments are operating in the most efficient manner possible, primarily by avoiding duplication of effort and through resource sharing. (DBO)

Sullivan B.K., P.H. Doering, C.A. Oviatt, A.A. Keller, and J.B. Frithsen. 1991. Interactions with the Benthos Alter Pelagic Food Web Structure in Coastal Waters. Canadian Journal of Fisheries and Aquatic Sciences. 48(11):2276-2284.

Abstract: Results from studies in experimental enclosures containing both water column and benthic communities show that the benthos has an important effect on the structure and productivity of pelagic food webs whether the system is nutrient enriched or nutrient limited. Research over a 10-yr period in 13-m3 mesocosms showed that changes in the pelagic food web were correlated with different sediment communities and with the presence or absence of a benthos. The abundance of copepods was inversely correlated with numbers of macrofauna. At both low and high nutrient levels, systems without benthos had greatly enhanced numbers of carnivorous holozooplankton including ctenophores, medusans, chaetognaths, and fish. Our observations indicate that the presence of the benthos shortens the pelagic food web and inhibits the response of pelagic fauna to nutrient enrichment in well-mixed coastal waters. The strength of benthic-pelagic coupling, which is controlled by the amount of turbulence in the water column, may be more important to food web structure than the rate of nutrient supply and could determine which subsystem responds to eutrophication.

Swanson, C. and M. Spaulding. 1977. Nearshore Wave Climate for Block Island Sound. Department of Ocean Engineering, University of Rhode Island. Kingston, RI.

Abstract: A computer simulation of the wave climatology at Charlestown, Rhode Island, was undertaken by the Department of Ocean Engineering in response to a request by the coastal resources center of the University of Rhode Island. The purpose of this study was to determine the wave induced effects, if any on the proposed intake structures for the planned nuclear electric generating plant at the Charlestown air station. This report describes the procedures employed in the calculation for generating wave ray paths as well as obtaining suitable bathymetric data for use in the computer program and the wave conditions used as input to the program.

Swanson, J.C. and D. Mendelsohn. 1998. Velocity Estimates for Candidate Dredged Material Disposal Sites in Narragansett Bay. ASA Project 97-059. Applied Science Associates. Narragansett, RI.

Abstract: The USACE has been actively assessing potential or candidate dredged material disposal sites around Narragansett Bay. They have identified five sites around Prudence Island, shown in Figure 1.1, for further study. As part of that study, Science Applications International Corporation (SAIC), as a contractor to the New England District, retained Applied Science Associates, Inc. (ASA) to use its hydrodynamic modeling expertise to assess the expected maximum tidally induced current speeds at each site. Different levels of filling were also to be examined to determine the sensitivity of each site to changes in depth.

This report documents ASA's predictions of maximum current speeds under a variety of tidal conditions. The next section discusses the model used in the analysis, Section 3 documents the model application to this problem, Section 4 presents results, Section 5 provides conclusions from the study and Section 6 includes references.

Swanson, R.A. 1971. Structure, Diversity, and Homogeneity of Benthic Epifaunal Communities, Buzzards Bay, Massachusetts. Page C92-C96. U.S. Geol. Survey Prof Paper 575-C.

Abstract: The present study attempts to examine populations from three encrusting epifaunal communities in shallow marine environments. In particular, the faunal diversity, faunal homogeneity, and the distribution of individuals within the community are examined. The living fauna, including both soft-bodied organisms and those with hard parts suitable for preservation, is compared to the preservable fauna as regards all three of these aspects of the study. This comparison provides information essential to the paleoecologic interpretation of shell encrusting organisms. Paleoecologic interpretations, based on fossil faunas, achieve validity only when the degree to which fossil faunas reflect living faunas is clearly understood.

Tammi, K.A., S.J. Soares, W.H. Turner, and M. Rice. 1994. Settlement and Recruitment of Bay Scallops, *Argopecten irradians*, to Artificial Spat Collectors in the Westport River Estuary, Westport, Massachusetts. Journal of Shellfish Research. 13(1):321.

Abstract: In January 1993, The Water Works Group initiated the Bay Scallop Restoration Project as an attempt to restore the once prolific bay scallop population within the Westport River Estuary in Massachusetts. The project is a multiphase endeavor aimed at better understanding recruitment failures of both natural stocks and introduced seed of Argopecten irradians. The main objective was to assess larval settlement and juvenile recruitment (survival to > 4 mm) to artificial spat collectors placed in historically productive scallop beds and within close proximity to adult spawner rafts. This study shows that A. irradians will settle on artificial spat collectors containing monofilament, which may have two major implications in resource management. First, spat collectors may be a means to predict recruitment into the bay scallop fishery. Second, juvenile scallops harvested from spat collectors could be utilized for other grow-out applications to enhance natural stocks. Consequently, the implementation of spat collectors into an overall management plan could be a method employed by coastal communities to improve, stabilize and restore bay scallops in Southern New England and elsewhere.

Teal, J.M., J.W. Farrington, K.A. Burns, J.J. Stegeman, B.W. Tripp, B. Woodin, and C. Phinney. 1992. The West Falmouth Oil Spill After 20 years: Fate of Fuel Oil Compounds and Effects on Animals. Marine Pollution Bulletin. 24(12):607-614.

Abstract: The barge *Florida* spilled No. 2 fuel oil into Buzzards Bay, Massachusetts on 29 September 1969. Sediments from five of the original stations were sampled in August 1989 and analyzed for fuel oil hydrocarbons. Two subtidal and one intertidal marsh station showed no evidence of fuel oil. One subtidal mud core had traces of biodegraded fuel oil at 10-15 cm. One marsh core contained 10^{-6} g g^{-1} dry wt of weathered and biodegraded fuel oil aromatic hydrocarbons and cycloalkanes at 5-10 cm with lesser concentrations at 0-5 and 10-15 cm. Although present in trace concentrations, these hydrocarbons appear to be slightly inducing cytochrome P4501A in marsh fish (*Fundulus heteroclitus*).

Teas, W.G. 1994. Marine turtle stranding trends, 1986 to 1993. NOAA Tech. Memo. NMFS-SEFC-351. Pages 293-295 Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Eliazar. (Eds.), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. 323.

Abstract: The Sea Turtle Stranding and Salvage Network (STSSN) was established in 1980 to document strandings of marine turtles along the U.S. Gulf of Mexico and Atlantic coasts. The network encompasses the coastal areas of the eighteen state region from Maine through Texas, and includes portions of the U.S. Caribbean (Puerto Rico and the U.S. Virgin Islands). This poster summarizes data compiled through the efforts of network participants from 1986 through 1993.

Theroux, R.B. and R.L. Wigley. Distribution and Abundance of East Coast Bivalve Mollusks based on Specimens in the National Marine Fisheries Service Woods Hole Collection. NOAA-TR-NMFS-SSR-768. National Marine Fisheries Service. Washington, DC. 192 pp.

Abstract: The distribution and numerical abundance of over 108,000 specimens of bivalve mollusks (81% of which were alive when captured) collected and maintained by the Benthic Dynamics Investigation at the NMFS Northeast Fisheries Center at Woods Hole, Mass., are presented. They are illustrated in a series of charts, and their bathymetric range and bottom sediment preferences are outlined in tabular form. Taxonomic groups represented include 5 subclasses, 8 orders, 46 families, 99 genera, and 164 species. The specimens are contained in 10,465 lots from 2,767 sampling sites along the east coast continental shelf and slope, and upper continental rise between Nova Scotia and southern Florida. Samples range in depth from 0 to nearly 4,000 m. The collections were obtained by a variety of research vessels and persons using quantitative and qualitative sampling devices (*i.e.*, grabs, dredges, trawls, *etc.*) over a period of 21 yr. Also included are current vernacular names, zoogeographic data, and a reference to the original description of represented species.

The data upon which this report is based are stored on magnetic tape and disc files, and the specimens are stored in a Specimen Reference Collection at the Northeast Fisheries Center in Woods Hole, Mass.

Theroux, R.B. and R.L. Wigley. 1998. Quantitative composition and distribution of the macrobenthic invertebrate fauna of the continental shelf ecosystems of the northeastern United States. Page 240. Volume NOAA Technical Report NMFS 140. NOAA. Washington, DC.

Abstract: From the mid-1950s to the mid-1960s a series of quantitative surveys of the macrobenthic invertebrate fauna were conducted in the offshore New England region (Maine to Long Island, New York). The surveys were designed to 1) obtain measures of macrobenthic standing crop expressed in terms of density and biomass; 2) determine the taxonomic composition of the fauna (ca. 567 species); 3) map the general features of macrobenthic distribution; and 4) evaluate the fauna's relationships to water depth, bottom type, temperature range, and sediment organic carbon content. A total of 1,076 samples, ranging from 3 to 33,974 m in depth, were obtained and analyzed.

The aggregate macrobenthic fauna consists of 44 major taxonomic groups (phyla, classes, orders). A striking fact is that only five of those groups (belonging to four phyla) account for over 80% of both total biomass and number of individuals of the macrobenthos. The five dominant groups are Bivalvia, Annelida, Amphipoda, Echninoidea, and Holothuroidea.

Other salient features pertaining to the macrobenthos of the region are the following: substantial differences in quantity exist among different geographic subareas within the region, but with a general trend that both density and biomass increase from northeast to southwest; both density and biomass decrease with increasing depth; the composition of the bottom sediments significantly influences both the kind and quantity of macrobenthic invertebrates, the largest quantities of both measures of abundance occurring in the coarser grained sediments and diminishing with decreasing particle size; areas with marked seasonal changes in water temperature support an abundant and diverse fauna; and no detectable trends are evident in the quantitative composition of the macrobenthos in relation to sediment organic carbon content.

Thomas, E.L. 1966. A Study of the Nantucket-Vineyard Ferry Lines, 1800-1948.

Thompson, B.P. 1985. Evaluation of the U.S. Army Corps of Engineers' Decision-making Process for Selection of Dredged Material Disposal Sites.

Abstract: This study evaluates the decision-making process of the U.S. Army Corps of Engineers (COE) as it applies to the selection of land or open-water disposal sites for sediment from dredging projects planned by the COE. The study seeks to illustrate:
1) the structure of the COE decision-making process as provided for in laws, regulations, and COE policies;
2) the operational, economic, and environmental variables that might influence COE decision-making;
3) how the New England Division of the COE makes decisions on disposal sites for dredged material through consideration of operational, economic and environmental objectives.

The study finds that the COE decision-making process, with respect to dredged material disposal, is structurally complex and bureaucratic in nature. It is characterized by the interaction of numerous laws, regulations, federal agencies, and public and private interests. The process is designed to accommodate potentially conflicting interests and objectives.

There are many potentially important variables involved in the decision-making process. The possibility of conflicts between operational, economic and environmental objectives requires flexibility in decision-making. Because the potential environmental effects of dredged material disposal are still poorly understood, the environmental objective is the one most easily compromised.

Based upon the quantitative evaluation performed in this study, the operational economic and environmental variable groups that were examined appear to have little or no influence on disposal site decision-making in the New England Division (NED) of the COE. This suggests that, in practice, the NED decision-making process is loosely structured, project specific, and highly subjective in nature. That finding is probably a function of the complex nature of both the dredged material disposal problem and the decision-making process.

It is difficult for the NED decision-makers to objectively assess the same set of variables in each disposal decision. The diversity of potentially important variables, and the variability of project conditions make the application of broad-scale decision rules impractical. The decision-making process must be flexible enough to accommodate the special considerations of each project. As a result, disposal site selections must be made on a project-by-project basis, and are ultimately subjective in nature.

The findings of this study raise an interesting issue in terms of the COE's environmental regulatory requirements. The New England Division does not appear to be making an attempt to exclude or restrict all potentially contaminated dredged material from open-water disposal. It seems that dredged material is excluded from open-water disposal only if it obviously violates current regulatory standards. Little effort is made to restrict the discharge of material that may be marginally contaminated, so long as it complies with the regulations.

If these findings reflect the policy of the New England Division, that policy may or may not be justified in light of the uncertainty surrounding the potential adverse environmental impacts of dredged material disposal. The issue of contention is that, even though such a policy fulfills the regulatory requirements, it does not fully conform to the intent of Congress as expressed in the legislation.

Tippie, V.K. 1977. Dredging and the Disposal of Dredged Materials in Rhode Island: Prepared for Rhode Island Coastal Resources Management Council. Coastal Resources Center, University of Rhode Island.

Abstract: This document is the result of discussions, and several months of research conducted by the Coastal Resources Center of the University of Rhode Island for the Rhode Island Coastal Resources Management Council. The Council has long recognized the need to develop viable alternatives for the disposal of dredged material. Findings and developments are from a workshop including presentation from various speakers.

Topp, R.W. 1968. An Estimate of Fecundity of the Winter Flounder, *Pseudopleuronectes americanus*. Journal of the Fisheries Research Board of Canada. 25:1299-1302.

Turner, S.C., C.A. Brown, and H. Huang. 1997. Standardized Catch Rates of Small Bluefin Tuna, *Thunnus thynnus*, from the U.S. Rod and Reel Fishery off Virginia-Rhode Island in 1980-1995. Collect. Vol. Sci. Pap. 46(2):295-310.

Abstract: Standardized catch rates for small bluefin tuna (Thunnus thynnus) were developed using data from the rod and reel fishery off the northeast USA (Virginia to Massachusetts) during 1980-1985.

Turner, W.H., K.A. Tammi, and M.A. Rice. 1997. "Bags to Drags," The Story of the Bay Scallop Restoration Project. Journal of Shellfish Research. 16:276.

Abstract: In an effort to focus widespread public attention on the economic value of clean and productive estuaries, The Water Works Group, Inc. founded by Bay Scallop Restoration Project (BSRP) in the Westport River (Massachusetts and Rhode Island). Since its spawning in January 1993, the BSRP has devised and set into action an innovative bay scallop propagation program employing uniquely simple equipment and a large cast of community players. Success in generating viable shell fishing opportunities in Westport has led to the expansion of this initiative to Apponagansett Bay in Dartmouth, Massachusetts. Building on four years of research, investigations have sought to examine the life stages of bay scallops (Argopecten irradians) from spawn to settlement in five distinct areas in the Westport River and four in

Apponagansett Bay. Experimental results in 1993, 1994, and 1995 have demonstrated the significance of "spawning sanctuaries." These sanctuaries concentrate a broodstock and when coupled with "spat bags" (equipment designed to collect a sample of the juvenile offspring) have recorded volumes of data vital to the understanding of bay scallop recruitment dynamics. Information retrieved from more than 6,000 spat bags have clued researchers into the impacts and significance of: predation (particularly that of mud crabs), fouling organisms, and shellfish spawning events, *i.e.* larval development, settlement selection, and timing. As a result of this research initiative, three consecutive viable "wild" bay scallop crops have occurred in the Westport River leading to a substantial increase in the number of commercial and recreational scallopers. In turn, this has generated an unprecedented interest focused on improving water quality for further enhancement of commercially valuable shellfish, including oysters, quahogs, and soft-shell clams. Visible and valuable research with an economic end involving public/private partnerships between The Water Works Group and volunteers, local schools, town boards, state agencies, universities, and other nonprofit entitles have played a significant role in instilling the vision of this experiment in the minds of thousands of people. So significant is this undertaking, that not only is Westport on the eve of its best scallop season since 1985, but in the four years this project has been drawing attention to the need for high water quality standards, more than 1,200 acres out of 3,000 have been reopened to shellfishing in Westport, allowing resident and commercial fishermen to harvest quahogs, steamers, and oysters deemed off-limits for nearly twenty years. (DBO)

U.S. Army Corps of Engineers. 1991. Buzzards Bay Disposal Site Baseline Study, March 1990. Disposal Area Monitoring System DAMOS. U.S. Army Corps of Engineers, NAE. Concord, MA.

Abstract: From 27 to 29 March 1990, field operations were conducted at the Buzzards Bay Disposal Site to provide information on the effects of past disposal operations and establish baseline conditions for future monitoring. Field operations included a precision pathymetric survey, REMOTS® sediment profile photography, and sediment sampling for benthic, chemical, and physical analyses.

The information obtained from the bathymetric survey and REMOTS® photos permitted the detection of two disposal mounds within the surveyed area. The primary mound was central to the disposal site, 1.2 m high and 60 m wide. The other, south and west of the center mound, was 1.6 m high and approximately 90 m wide.

The major modal grain size over the surveyed area ranged from medium sand (2-1 phi) to silt-clay (≥4 phi). All stations containing a major mode of medium (2-1 phi) and fine (3-2 phi) sand fractions were rippled. The distribution of the major modal grain size, as deduced from REMOTS® photographs, indicated a net bedload sediment transport of fine-grained material to the southeast along an 11.6 m isobath. Currents are most likely the dominant force contributing to the transport. The disposal site center consisted of rippled bedforms and fine sands which limited penetration by the REMOTS® camera.

The species composition found in this study was similar to that of benthic communities in Cape Cod Bay and Boston Harbor/Massachusetts Bay. Sediment chemistry and grain size analysis results indicated expected levels of percent fines, metals, PAHs, PCBs, and pesticides. Currently, the surveyed area is healthy biologically and relatively uncontaminated.

U.S. Army Corps of Engineers. 1979. DAMOS Disposal Area Monitoring System Annual Data Report - 1978 Supplement E Brenton Reef Disposal Site New England Division Corps of Engineers. 36 pp.

Abstract: This is one of a series of site-specific data reports resulting from the DAMOS program, now two years in progress. DAMOS is the culmination of nearly a decade of prior study efforts, actually preceding NEPA, which have been directed towards the understanding of the effects of and the responsible management of the ocean disposal of dredged materials in New England waters as they fall under the authority of the New England Division of the Corps of Engineers. The individual site reports henceforth will be updated approximately on an annual basis as additional knowledge is gained, at least with respect to those sites where significant disposal activities will have occurred.

U.S. Army Corps of Engineers. 1980. Environmental Atlas of New England Channel and Harbor Bottom Sediments Vol. II. Federal Projects within Narragansett Bay, Mount Hope Bay, Block Island and Buzzards Bay.

U.S. Army Corps of Engineers. 1980. Environmental Atlas of New England Channel and Harbor Bottom Sediments Vol. III. Section A, Nantucket Sound, Vineyard Sound and Eastern Buzzards Bay.

U.S. Army Corps of Engineers. 1996. Inventory of Dredging Needs in the Designated Port Areas of Massachusetts: 1996-2016. U.S. Army Corps of Engineers, New England Division. Waltham, MA.

> **Abstract:** This is a computer printout of facilities along the coast of Massachusetts that were identified as having a need to dredge between 1996 and 2016. The list includes the waterway, site name, status, purpose, facility type, name of operator, name of owner, and latitude/longitude coordinates.

U.S. Army Corps of Engineers. 2001. Long Island Sound Dredged Material Disposal Environmental Impact Statement. Dredging Needs Navigation-Dependent Facilities. Pages 43-59. US Army Corps of Engineers, New England District. Waltham, MA.

> **Abstract:** A listing of navigation-dependent facilities located in Rhode Island, identified in support of the Long Island Sound Dredged Material Disposal EIS. The town where the facility is located, name of facility, address, phone number, date last dredged, quantity last dredged, amount sent to DAMOS, and projected amount of maintenance dredging over the next 5, 10, 15, and 20 yrs is listed.

U.S. Army Corps of Engineers. 1995. The National Dredging Needs Study of Ports and Harbors. [Microform]. Literature Search. Prepared by DRI/McGraw-Hill. Institute for Water Resources, Water Resources Support Center. Alexandria, VA.

> **Abstract:** This report is part of a series of reports, which are being published by the U.S. Army Corps of Engineers during the National Dredging Needs Study. It is a survey of available information on dredging and associated points of contact.

U.S. Army Corps of Engineers. 1970. National Shoreline Study, North Atlantic Region Vol. I. U.S. Army Corps of Engineers, North Atlantic Division. New York, NY.

U.S. Army Corps of Engineers. 1970. National Shoreline Study, North Atlantic Region Vol. II. U.S. Army Corps of Engineers, North Atlantic Division. New York, NY.

U.S. Army Corps of Engineers. 2001. Providence River and Harbor Maintenance Dredging Project Final Environmental Impact Statement. U.S. Army Corps of Engineers. Concord, MA.

> **Abstract:** The present condition of the Providence River Federal channel and harbor requires that up to 4.3 million cubic yards (cy) (3.3 million m^3) of material be dredged to restore the Congressionally authorized project dimensions. Additional material may be generated through the construction of Confined Aquatic Disposal (CAD) cells to management material classified as unsuitable for open water disposal and from associated non-Federal dredging projects. These projects could raise the total volume for disposal in Rhode Island Sound to as much as 5 million cy (3.8 million m^3). There is no designated disposal site in Rhode Island. The 5 million cubic yards of dredged material would require a substantial area. Disposal at an open water site, such as Site 69b, could cover as much as 800 acres (3.2km^2) of the bottom.
>
> A detailed discussion of dredges activities, dredge machinery and potential disposal locations and quantities considered for the project and a comparison of alternatives is provided in the FEIS. A

description of the portion of the proposed action that has the potential to affect threatened and endangered species is provided below. More detailed information regarding the proposed action is provided in the FEIS.

U.S. Army Corps of Engineers. 1985. Rhode Island Sound Regional Disposal Site Study: Rhode Island and Southeastern Massachusetts Dredging Needs Survey:1985-1995. SAIC Report No. SAIC-84/7520&C45. U.S. Army Corps of Engineers, NAE. Concord, MA.

Abstract: A reassessment of the dredging needs for the Rhode Island Sound, Southeastern Massachusetts, Martha's Vineyard, Nantucket, Block Island, and Buzzards Bay geographical area. The objectives of this survey are the identification, classification, and projection of anticipated dredging needs for a ten-year period from 1985-1995. This is in response to demands from water dependent businesses and congressional interest in safe disposal of dredged material. The results of the survey show the need for dredging within the next ten years, and outline the specific amounts to be dredged in each region.

U.S. Army Corps of Engineers, SAIC. 1990. Index of SR - Reports. Disposal Area Monitoring System DAMOSU.S. Army Corps of Engineers. 74 pp.

This document contains the index of each individual SR-report prepared for NED. Prior to the initiation of the Disposal Area Monitoring System (DAMOS), the New England Division (NED) of the US Army Corps of Engineers relied on individual contracts with environmental experts in the New England Area to conduct studies related to the disposal of dredged material. The results of these studies are presented in a series of reports (SR-reports) produced from 1969 to 1980 and includes information on dredged material and its physical, chemical, and biological impacts on the environment.

This document is a companion volume to the collection of indices produced for the DAMOS Contributions.

U.S. Army Corps of Engineers and SAIC. 1990. Preliminary Field Operations in Support of Disposal Site Designation in the Rhode Island Sound Region. SAIC-88/7525 & C69. Disposal Area Monitoring System DAMOS, Contribution No. 79. U.S. Army Corps of Engineers, New England Division.

Abstract: During the period 4 September to 14 October 1987, field operations were conducted in selected areas of Rhode Island Sound (RIS) and Narragansett Bay to gather information for a feasibility assessment of offshore dredged material disposal sites. A total of four discrete areas were studied; three in RIS (Brenton Reef, Brenton-A, and Brenton-B) and one in Narragansett Bay (Prudence). Field operations included bathymetric, side scan and sub-bottom surveys, sediment-profile photography (REMOTS®), and sediment sampling for physical and benthic community analyses.

The physical boundaries of the historic disposal mound at the Brenton Reef disposal site had not changed since the last (1981) survey of the area; the mound was a well-defined feature centered just inside the western boundary of the disposal site with a diameter of roughly 1600 meters and a minimum depth at the apex of 25.5 meters. The areas of Brenton-A and Brenton-B were characterized by extensive glacial drift deposits. A relict channel system that drained the landward side of the recessional moraine was observed in sub-bottom profiles trending northeast-southwest through these two areas. The Prudence Island site side-scan data revealed mound-like features (< 2 m in height; 10-20 m in diameter) on an otherwise uniform surface.

The benthic communities around the Brenton Reef disposal mound showed a full recovery in population density since the cessation of disposal operations. Dense ampeliscid beds were observed on the ambient seafloor within and outside the site as well as on the edge of the mound; a mobile sand community dominated the mound central area where a distinct transition in sediment grain size occurred. The density of lobster traps on and around the disposal mound attested not only to the benthic community recovery but also to the enhanced fishery resource, which exists at the site.

U.S. Army Corps of Engineers Waterways Experiment Station, Environmental Laboratory. 1997. Dredging Operations and Environmental Research: Program Products [Electronic Resource]. U.S. Army Engineer Research and Development Center. Vicksburg, Miss.

U.S. Coast and Geodetic Survey. 1943. Tidal Current Charts, Torpedo Range, Block Island Sound. Department of Commerce, U.S. Coast and Geodetic Survey. Washington, DC.

> **Abstract:** Current Charts that show the hourly direction and velocity of the tidal current as observed below the surface at four locations along the Torpedo Range and Block Island Sound and a reference station. They present a comprehensive view of the tidal current movement along the range and also supply a means for readily determining for any time the direction and velocity of the current at the several locations.

U.S. Congress, U.S. Senate, Committee on Interior and Insular Affairs, and Subcommittee on Parks and Recreation. 1973. To Establish the Nantucket Sound Islands Trust: Hearing, Ninety-third Congress, first session, on S. 1929 Nantucket and Tisbury, Massachusetts July 16, 1973. U.S. Govt. Printing Office. Washington, DC.

U.S. Congress, U.S. Senate, Committee on the Judiciary, and Subcommittee on Administrative Practice and Procedure. 1977. Oil Spill off Nantucket, Massachusetts: Hearing before the Subcommittee on Administrative Practice and Procedure of the Committee on the Judiciary, United States Senate, Ninety-fourth Congress, second session December 22, 1976. U.S. Govt. Printing Office. Washington, DC.

U.S. Department of Commerce. 1958. Tidal Current Charts, Long Island Sound and Block Island Sound. 4th ed. U.S. Department of Commerce, Coast and Geodetic Survey. Washington, DC.

> **Abstract:** Tidal charts from 1958 of the currents throughout Long Island Sound and Block Island Sound. The charts include both incoming and outgoing currents.

U.S. Dept Commerce and NOAA NMFS. National Benthic Surveillance Project: Northeast Coast. TM-4: Appendix. NOAA-NWFSC Tech Memo-4. U.S. Dept Commerce/NOAA/NMFS/MWFSC/Publications. 5 pp: http://www.nwfsc.noaa.gov/pubs/tm/tm4/appendix.htm.

> **Abstract:** Mean lengths, weight, ages (± SD), and sex ratios of winter flounder at Northeast Coast sampling sites. Values in bold type are significantly different ($p \leq 0.05$) from values at the Rocky Point, Long Island Sound reference site, as determined by ANOVA for length, weight, and age and the Herogeneity G-Test for gender ratio.

U.S. Environmental Protection Agency, Sediment Oversight Technical Committee. 1990. Managing Contaminated Sediments [Microform]. EPA Decision-making Processes. EPA 506/6-90/002. U.S. Environmental Protection Agency, Sediment Oversight Technical Committee. Washington, DC.

> **Abstract:** The purpose of this document is to summarize how the Environmental Protection Agency (EPA) makes decisions with regard to managing contaminated sediments. Traditionally, contaminated sediments have been most closely regulated by the Office of Marine and Estuarine Protection (OMEP) under the Marine Protection, Research, and Sanctuaries Act (MPRSA) for ocean dumping and the Office of Wetlands Protection (OWP) for dredge and fill activities under the Clean Water Act (CWA). In recent years, however, it has become increasingly apparent that the scope of the contaminated sediments problem extends far beyond this traditional context. A comprehensive management program is needed in order to address the range of contaminated sediment issues.

U.S. Fish and Wildlife Service. "Endangered Species for RI and MA Region 5 Listings by State and Territory (as of 4/4/2002)". *US Fish and Wildlife Service* .http://ecos.fws.gov/webpage/webpage_region_lists.html?lead_region=5#RI.

> **Abstract:** A listing of threatened and endangered species for each state from the Threatened and Endangered Species System (TESS). Includes Connecticut, Rhode Island, Massachusetts, and other States. Printed 4/4/2002.

U.S. Fish and Wildlife Service. "U.S. Listed Invertebrate Animal Species Report by Taxonomic Group". *U.S. Fish and Wildlife Service.* *http*://ecos.fws.gov/webpage/webpage_vip_listed.html?module=undefined&code=I&listings=0#K.

> **Abstract:** A listing of all threatened and endangered invertebrate animal species by taxonomic group state from the Threatened and Endangered Species System (TESS) as of 4/23/2002. Includes clams, snails, insects, arachnids, and crustaceans.

URI Division of Marine Resources. 1977. A Study and Report on Oceanographic Conditions in the Vicinity of Browns Ledge, Rhode Island Sound. Report No. 2. Division of Marine Resources, Graduate School of Oceanography, University of Rhode Island. Kingston, RI.

Valente, R. 2001. November 2000 Baseline Characterization of Benthic Macroinvertebrate Communities at Two Candidate Dredged Material Disposal Sites in Buzzards Bay. Massachusetts Coastal Zone Management Agency. Boston, MA.

> **Abstract:** A comprehensive effort was undertaken in November 2000 to characterize baseline physical, chemical, and biological conditions at two candidate dredged material disposal sites in eastern Buzzards Bay and two nearby reference areas. As part of this survey effort, grab samples were collected to characterize the benthic macroinvertebrate communities inhabiting the surface sediments within candidate Sites 1 and 2 and reference areas REF-NEW and REF-2. The benthic communities at the four sites were found to be comprised of roughly similar proportions of the following major groups: annelids, mollusks, crustaceans, nematodes, and nemerteans. A grand total of 132,769 individuals belonging to 126 taxa were collected across all four sites, but the majority of these individuals belonged to a relatively small number of 13 taxa. Based solely on the similarity among the four sites in the taxa comprising the numerical dominants, it was concluded that they had broadly similar benthic communities at the time of the November 2000 survey.

Valente, R., J. Infantino, and B. Andrews. 2001. Results of the October 2000 Bathymetric Survey at Candidate Disposal Site 1 in Buzzards Bay. Massachusetts Coastal Zone Management Agency. Boston, MA.

> **Abstract:** A May 1998 bathymetric survey at the historic Cleveland Ledge Disposal Site in eastern Buzzards Bay revealed the presence of two distinct seafloor basins having water depths greater than 12 m; these basins were subsequently selected as potential dredged material disposal locations. The May 1998 bathymetric survey encompassed all of candidate Site 2, but only a portion of Site 1. Therefore, a second survey was conducted in October 2000 to obtain high-resolution bathymetric data encompassing all of Site 1 and its immediate surroundings area. This bathymetric survey was a part of a larger study to collect baseline physical and biological characterization data at candidate Sites 1 and 2 and nearby reference areas, in support of the overall disposal site designation effort.

Valente, R. and G. Tufts. 2001. November 2000 Baseline Characterization of Sediment Chemistry at Two Candidate Dredged Material Disposal Sites in Buzzards Bay. Massachusetts Coastal Zone Management Agency. Boston, MA.

Abstract: A comprehensive effort was undertaken in November 2000 to characterize baseline physical, chemical, and biological conditions at two candidate dredged material disposal sites in eastern Buzzards Bay and two nearby reference areas. As part of this effort, grab samples were collected to characterize sediment grain size and chemical contaminant concentrations within candidate Sites 1 and 2 and reference areas REF-NEW and REF-2.

On average, surface sediments at candidate disposal Site 1 were predominantly muddy (silt-clay), with a minor component of fine to medium sand. Sediments at candidate Site 2 were predominantly sandy, with lesser amounts of silt-clay. Surface sediments at reference areas REF-NEW and REF-2 had very high proportions of silt-clay (90% or more) and small amounts of fine to medium sand.

Total organic carbon (TOC) concentrations at the two candidate disposal sites and two reference areas were within typical ranges for fine-grained, coastal marine sediments and comparable to average TOC concentrations in other areas of Buzzards Bay located away from the pollution sources. The data suggests an absence of any long-term trends of either decreasing or increasing sediment contamination levels in this part of Buzzards Bay over the ten-year period 1990 to 2000.

Valente, R. and G. Tufts. 2001. November 2000 REMOTS® Survey at Two Candidate Dredged Material Disposal Sites in Buzzards Bay. Massachusetts Coastal Zone Management Agency. Boston, MA.

Abstract: A comprehensive effort was undertaken in November 2000 to characterize baseline physical, chemical, and biological conditions at two candidate dredged material disposal sites in eastern Buzzards Bay and two nearby reference areas. As part of this survey effort, REMOTS sediment-profile images were collected to characterize existing physical and biological seafloor conditions within candidate Sites 1 and 2 and reference areas REF-NEW and REF-2. The REMOTS Organism-Sediment Index values indicated that benthic habitat quality in and around Sites 1 and 2 was primarily non-disturbed, reflecting healthy sediment aeration and the presence of a diverse and abundant benthic community comprised of State I, II, and III organisms.

Valente, R., E. Waddell, and P. Hamilton. 2001. Evaluation of Baseline Water Column Chemistry and Sediment Resuspension Potential at Two Candidate Dredged Material Disposal Sites in Buzzards Bay. Massachusetts Coastal Zone Management Agency. Boston, MA.

Abstract: A comprehensive effort was undertaken in November 2000 to characterize baseline physical, chemical, and biological conditions at two candidate dredged material disposal sites in eastern Buzzards Bay and two nearby reference areas. As part of this effort, a bottom current study was conducted to evaluate the potential impact of currents and storm events at the two candidate disposal sites, specifically with respect to potential for sediment resuspension and transport. The bathymetric "depth difference" comparisons failed to detect any significant changes in depth (defined as greater than ± 0.5 m) in the vicinity candidate disposal Sites 1 and 2 over the ten year period 1990 to 2000. These results indicate an overall lack of long-term, significant sediment erosion potential in the immediate vicinity of candidate disposal Sites 1 and 2.

Valente, R.M., D.C. Rhoads, J.D. Germano, and V.J. Cabelli. 1992. Mapping of Benthic Enrichment Patterns in Narragansett Bay, Rhode Island. Estuaries. 15(1):1-17.

Abstract: A synoptic reconnaissance survey was performed over a five-day period in August 1988 to assess benthic habitat quality throughout Narragansett Bay, Rhode Island, using REMOTS® sediment-profile photography and analysis in combination with measurements of the levels of *Clostridium perfringens* spores (a fecal indicator) in sediments. Three main areas of degraded benthic habitat quality related to either excessive organic enrichment or physical disturbance were identified based solely on the REMOTS® analysis: the Providence River Reach, Greenwich Bay and its associated coves and harbors, and an area located along the southwest side of Prudence Island. Sediments at many stations in these areas exhibited shallow apparent redox-potential discontinuity (RPD) depths, high apparent oxygen demand, and low-order benthic successional stages. Elevated *Clostridium perfringens* spore counts in surface sediments

were attributed to inputs from wastewater treatment facilities. The highest spore counts occurred at the head of the bay, where wastewater treatment discharges and associated combined sewer overflows are numerous. Using data from the REMOTS® analysis and the sediment inventory of *C. perfringens* spores, a distinction was made between organic enrichment of the bottom from sewage, versus nonsewage enrichment or physical disturbance. The combination of techniques employed in this investigation could be used to design more efficient monitoring programs to assess eutrophication effects in estuaries and determine the effectiveness of regulatory or management initiatives to reduce organic overenrichment of benthic habitats.

Venkatesan, M.I., S. Steinberg, and I.R. Kaplan. 1988. Organic geochemical characterization of sediments from the continental shelf south of New England as an indicator of shelf edge exchange. Continental Shelf Research. 8(5-7):905-924.

Abstract: Organic geochemical determinations of total organic carbon (TOC), lignin and extractable alkanes, polycyclic aromatic hydrocarbons, fatty acids, alcohols, sterols, amino acids and carbohydrates have been performed on six cores collected during the SEEP—I cruises from the continental margin off southern New England. Our objective was to study the areal distribution and sources of the various classes of organic compounds, which would enable us to understand their transport from the shelf through slope to the rise.

Measured components in the cores in the mud patch region are homogeneously distributed throughout their length, indicating either bioturbation or low rate of mineralization in the sediments. The identifiable organic matter decreases from the shelf through slope to rise. A generally linear correlation is observed between TOC and most of the organic compound classes studied. Assuming that organic matter is transported by resuspension of sediment or along the sediment floor, we estimate that nearly 40–50% of the organic matter is exported to the slope from the shelf.

Wade, T.L. 1978. Sedimentary Geochemistry of Hydrocarbons from Narragansett Bay, Rhode Island; Incorporation, Distribution, and Fate. URI.

Abstract: Determining the impact of petroleum pollution in estuarine environments is essential, due to their biological importance. The Marine Ecosystems Research Laboratory (MERL) offers a unique opportunity to investigate the geochemical fate and biological effects of chronic petroleum addition to the productive Narragansett Bay estuary. The two main objectives of this research were to determine: (1) the geochemical distribution of hydrocarbons for Bay sediments, and (2) the mode of incorporation, distribution and fate of saturated hydrocarbons in the MERL ecosystem sediments.

The concentration of hydrocarbons (saturated, aromatic, biogenic, and anthropogenic) and chlorinated hydrocarbons (chlordane, DDT, and PCB's) in mid-Narragansett Bay was determined to provide additional information on their geochemical distribution. Anthropogenic materials (chlordane, DDT, PCB's and anthropogenic hydrocarbons) generally decrease with increasing depth in a core and reach background levels at depths consistent with the geochronology of this area of the Bay and the chronology of inputs of these materials. Bioganic materials (organic carbon and biogenic hydrocarbons) remained fairly constant with increased depth in a core. Size fractionation of two core sections showed more hydrocarbons (biogenic and anthropogenic) associated with the smaller size fraction ($< 45\ \mu$m to $> 0.3\ \mu$m) in the surface core section, while the lower section had slightly higher concentration for these hydrocarbons in the larger size fraction ($> 45\ \mu$m). These results indicate that the input of biogenic materials to this sedimentary environment has remained fairly constant over the time period covered by this core, while the input of anthropogenic materials has increased dramatically. It appears that the increased input of anthropogenic organic materials, including hydrocarbons, to this estuarine environment, is reflected by increased concentration of these materials in the upper layers of the sediments.

The second part of this investigation focused on the incorporation, distribution and fate of No. 2 fuel oil saturated hydrocarbons in sediments from the MERL ecosystems. Periodic additions of No. 2 fuel oil to the ecosystems simulated a chronic input. After the initial addition of oil, trace amounts were detected in

the sediments within two weeks, but substantial accumulation was not seen until approximately 135 days after the initial chronic oil addition. The majority of the No. 2 fuel oil saturated hydrocarbons were found to be associated with suspended material in the water. Size fractionation of both suspended material and sediments indicated the No. 2 fuel oil saturated hydrocarbons associate to a larger extent with the smaller size fraction (< 45 μm). Most of the No. 2 fuel oil saturated hydrocarbons are apparently carried to the sediments associated with smaller particle (< 45 μm to > 0.3 μm). Once they reach the sediments, these particles with their associated No. 2 fuel oil saturated hydrocarbons have been detected at depths of 3 to 4 cm below the surface. Although only 7 percent or less of the No. 2 fuel oil saturated hydrocarbons added to the ecosystems was found in the sediments, once incorporated in the sediment these materials are relatively stable. The No. 2 fuel oil saturated hydrocarbons were easily detectable 185 days after the last oil addition.

Studies on the bay cores indicate that the input of anthropogenic hydrocarbons has increased dramatically over the past 100 years, while the input of biogenic hydrocarbons and total organic carbon has remained relatively constant. Studies in the MERL tanks indicate that a fraction of the petroleum hydrocarbons from a chronic input would be transported to the sediments associated with smaller size particles. Once in the sediments these materials appear to be relatively stable. This same process is probably responsible for transport of hydrocarbon materials to Bay sediments.

Wahle, R.A. 1993. Recruitment to American Lobster Populations along an Estuarine Gradient. Estuaries. 16(4):731-738.

Abstract: This study evaluates patterns in the distribution and abundance of newly recruited (young-of-the-year) and older American lobster (*Homarus americanus* Milne Edwards) along a 22 km length of the Narragansett Bay estuary, Rhode Island, with particular attention to substratum associations. This not only represents the first assessment of benthic recruitment of this species along an estuary, but it is also the first study of lobster recruitment in southern New England. Censuses were conducted by divers in a substratum-specific manner. In cobble-boulder habitat, with the aid of a diver-operated suction sampler, I found newly recruited (5-10 mm carapace length) lobsters to be most abundant on the open coast, with numbers diminishing to zero in the upper bay. Visual censuses of older lobsters in the same habitat revealed a similar pattern. On featureless sedimentary habitats new recruits were absent and lobster densities were at least two orders of magnitude lower than in rocky habitats. In Narragansett Bay, rocky habitats comprise a small proportion of the bottom. The availability of such habitats, the relative importance of larval supply and potential physiological stress in limiting recruitment up-bay remain unclear.

Wang, H.P. 1977. Multi-leveled Finite Element Hydrodynamic Model of Block Island Sound. Page 4.69-4.93 In: Gray, W.G., G.F. Pinder, and C.A. Brebbia, (Eds.), Finite Elements in Water Resources. Pentech Press, London.

Wang, J.S., T.C. Lee, R.E. Wolke, and S.B. Saila. 1996. PCB and Heavy Metal Residues in Livers and Muscles of Winter Flounder (*Pseudopleuronectes americanus*) from Rhode Island waters. Toxicological and Environmental Chemistry. 55(1-4):19-30.

Abstract: A total of 414 Winter Flounder (Pseudopleuronectes americanus), a bottom-dwelling fish, were caught from Warwick Neck, Whale Rock (both in Narragansett Bay) and Quonochontaug Pond (a southern coastal lagoon) of Rhode Island for the analysis of pollutants. Residues of PCBs (polychlorinated biphenyls), Pb (lead), Cd (cadmium), Hg (mercury) and As (arsenic) were determined on individual or pooled liver and muscle samples of the species. Mean concentrations of all the analyzed pollutants for liver and muscle from Warwick Neck (near the mouth of the Providence River) considered as a relatively polluted area, were ranked highest among the three sites. The relationship between different seasons or collecting sites and PCB or Pb residues in both tissues were statistically significant ($p < 0.05$). Levels of PCB residues in the liver and muscle were also found to be correlated ($p < 0.05$) with the fish body size (length and weight). PCB and Hg residues in the muscle were all below the US FDA tolerance levels of 2.0 and 1.0 mu g g super(-1) (wet wt), respectively.

Weaver, M.J. and L.A. Deegan. 1996. Extension of the Estuarine Biotic Integrity Index across Biogeographic Regions. Bulletin of the Ecological Society of America. 77(3 Supplement Part 2):472.

Weinberg, J. 1995. Ocean Quahog. NOAA Technical Memorandum NMFS-NE-108. Pages 121-122. Status of the Fishery Resources off the Northeastern United States for 1994.

Weisberg, R.H. and W. Sturges. 1976. Velocity Observations in the West Passage of Narragansett Bay: A Partially Mixed Estuary. Journal of Physical Oceanography. 6:345-354.

Abstract: Narragansett Bay is a weakly stratified estuary comprised of three connecting passages of varying depths. The vertical distribution of horizontal velocity was observed in the West Passage using moored current meters. The instantaneous motion was characterized by semi-diurnal tidal currents of amplitude 25–60 cm s^{-1}. These currents exhibited a phase advance with depth (total water depth=12.8 m) ranging with lunar phase from 0–3 h. The net current time series obtained by filtering out motions at tidal and higher frequencies were found to be an order of magnitude less than the instantaneous motion and well correlated to the prevailing 2–10 m s^{-1} winds. For periodicities of 2–3 days, the coherence between the longitudinal components of wind and net near surface current was as high as 0.8 with the current lagging the wind by about 3 h. The mean near surface speed, obtained by averaging over one month, was 1.2±1.6 cm s^{-1}. The large error bounds were a result of the large variability of the net current time series (and *not* a result of inadequate sampling). A measure of this variability due to day-to-day changes in weather is given by the root mean square deviation of the net current time series of 2.6 cm s^{-1}. The net transport of water through the West Passage was observed to be seaward or landward over the entire water column for several days duration, with typical wind induced transport fluctuations of ±500 m^3 s^{-1}. Hence, a net communication of water exists between the East and West Passages with water flowing either way in response to the wind. Wind is concluded to be the dominant mechanism driving the net circulation in the West Passage of Narragansett Bay. This is in contrast with the classical views of gravitationally convected net estuarine circulation.

Weiss, H.M. 1995. Marine Animals of Southern New England and New York: Identification Keys to Common Nearshore and Shallow Water Macrofauna. State Geological and Natural History Survey of Connecticut Bulletin 115. CT. 303 pp.

Abstract: The purpose of these keys is to enable non-specialists to easily identify the common marine animals of this region. The keys have been written for anyone with a good high school of introductory college level background in biology. This book is intended to have a level of technical difficulty between that of the very rigorous and comprehensive keys and the more popular field guides. Only the most common animals occurring in the georegion are covered by this book. Groups that are primarily terrestrial (*i.e.* birds, insects *etc.*) are not covered as completely as strictly marine animals or those that have a special relationship with the marine environment (*i.e.* waterfowl).

Whitehouse, S.T. 1994. The Abundance and Distribution of *Crangon septemspinosa* in Narragansett Bay and the Importance of *C. septemspinosa* as a Predator of Benthic Macrofauna and Newly-Metamorphosed *Pleuronectes americanus* (Rhode Island). Ph.D. Dissertation. University of Rhode Island. Kingston, RI. 202 pp.

Abstract: The numerically dominant epibenthic predator in Narragansett Bay is the sand shrimp, Crangon septemspinosa. Trawl samples taken throughout the bay during an annual cycle showed that in general the abundance of shrimp was at a maximum during the summer and lowest during the winter months. This pattern appears to be largely a result of springtime recruitment into the adult population.

The effect of C. septemspinosa on the abundance of benthic macrofauna due to both predation and disturbance was examined using three experiments. There were some problems with the experimental designs, which make extrapolation to the field difficult. Still, these experiments showed that C.

septemspinosa was capable of consuming from 12-33% of its body weight (dry) in prey per day and that disturbance by shrimp did not appear to be a significant source of mortality for benthic macrofauna.

Predation by C. septemspinosa of newly settled winter flounder (Pleuronectes americanus) was also examined using laboratory experiments. Predation by shrimp caused significant declines in the numbers of fish during the experiment with each shrimp consuming on average 0.4 fish per day.

Whitlatch, R.B. 1982. The Ecology of New England Tidal Flats: A Community Profile. FWS/OBS-81/01. U.S. Fish and Wildlife Service, Biological Services Program. Washington, DC. 125 pp.

Abstract: The purpose of this report is to provide a general perspective of tidal flats of New England, the organisms commonly associated with them, and the importance of tidal flats to the coastal zone viewed as a whole. The approach is taxonomically based although there is also attention paid to the flow of organic matter through the tidal flat habitat. The method of presentation is similar to that of Peterson and Peterson (1979) who have described the tidal flat ecosystems of North Carolina. The reader, therefore, has the opportunity of comparing and contrasting the physical and biological functioning of the two regions. Chapter 1 begins with a general view of the physical, chemical, and geological characteristics of tidal flat environments followed by a discussion of organic production and decomposition processes vital to these systems (Chapter 2). The next three chapters deal with the benthic invertebrates (Chapter 3), fishes (Chapter 4), and birds (Chapter 5) common to New England tidal flats. The coverage within each chapter reflects the published information available at the time of writing in addition to the author's perception about the structure, function, and importance of each of the taxonomic groups to the overall tidal flat system. The last chapter (Chapter 6) considers the response of tidal flats to environmental perturbation as well as their value to the New England coastal zone.

Wigley, R.L. and B.R. Burns. 1971. Distribution and Biology of Mysids (Crustacea, Mysidacea) from the Atlantic Coast of the United States in the NMFS Woods Hole Collection. Fishery Bulletin. 69(4).

Abstract: Nineteen species of marine mysids, representing 16 genera, have been assembled at the NMFS Biological Laboratory, Woods Hole, Mass. These specimens were collected between 1953 and 1969 from the continental shelf and slope off the east coast of the United States between Canada and southern Florida. The species represented are : *Eucopia grinaldii, Boreomysis tridens, Bowmaniella portoricensis, Auchialina typical, Erythrops crythrophthalma, Meterythrops robusta, Hypererythrops caribbaea, Pseudomma affine, Pseudomma* sp., *Amblyops abbreviate, Bathymysis renoculata, Mysidopsis bigelow, M. furca, Promysis atlantica, Mysis mixta, M. stenolepis, Praunua flexuosus, Neomysis Americana,* and *Heteromysis Formosa.*

Wigley, S.E. and W.L. Gabriel. 1991. Distribution of Sexually Immature Components of to Northwest Atlantic Groundfish Species based on Northeast Fisheries Center Bottom Trawl Surveys, 1968-86. NOAA Tech. Memo NMFS-F/NEC-80. 24 pp.

Abstract: Analyses of data obtained from research vessel survey cruises over a 19-year period reveal distinctive patterns in the geographic occurrence of immature fish. These occurrences provide qualitative evidence for potentially significant fishing mortality of the sexually immature components of 10 species in the Gulf of Maine-Georges Bank-Southern New England region, where substantial overlap exists between unregulated mesh/exempted fishing areas and the distributions of these immature fish.

Wigley, S.E. and F.M. Serchuk. 1992. Spatial and Temporal Distribution of Juvenile Atlantic Cod *Gadus morhua* in the Georges Bank-Southern New England Region. Fishery Bulletin. 90(3):599-606.

Abstract: Commercial landings data and research-vessel survey data collected by the Northeast Fisheries Science Center during 1982-86 were analyzed to identify spatial and temporal patterns as well as possible mechanisms associated with juvenile cod Gadus morhua distribution. Analysis of survey data indicated that cod ages 1-2, age 3, and age 4+ were distributed at different depths during the spring, however, during the autumn, age-3 fish co-occurred with age 1-2 fish. Analysis of commercial landings data revealed the

following patterns of distribution for age-2 cod: In quarter 1, concentrations appeared in the Nantucket Shoals region and the central portion of Georges Bank; in quarter 2, the concentration was northeast of Nantucket Shoals and also remained on Georges Bank; in quarter 3, both aggregations moved northeastward into deeper waters, along the 100 m contour of the Great South Channel and the Northern Edge, respectively; and in quarter 4, the Nantucket Shoals concentration had moved southwestward to shallower water, resuming locations identified in quarter 1, while the Georges Bank concentration remained as in quarter 3. While intraseasonal spatial distributions did not appear to be defined by temperature, seasonal shifts in concentration of juvenile cod were most likely associated with temperature.

Wilbur, D. and D. Clarke. 2002. Biological Effects of Suspended Sediments Impacts on Fish and Shellfish with Relation to Dredging Activities in Estuaries. North American Journal of Fisheries Management 21: 855-875.

Wiley DN, Asmutis RA, Pitchford TD, Gannon DP. 1995. Stranding and Mortality of Humpback Whales, *Megaptera novaeangliae*, in the Mid-Atlantic and Southeast United States, 1985-1992. Fishery Bulletin 93:196-205.

Abstract: Marine mammal strandings are a result of, or result in, mortality that may be attributed to natural or anthropogenic factors. As such, stranding data can provide insight on spatial distribution, seasonal movements, and mortality factors pertaining to marine mammal populations (Woodhouse, 1991; Mead).

The general distribution and migratory movements of humpback whales, *Megaptera novaeangliae*, in the western North Atlantic are well known from numerous studies based on the identification of individual animals and on other techniques. Humpbacks feed in high latitude areas during the summer months, including waters of the Gulf of Maine, eastern Canada, West Greenland, and Iceland (Hain et al., 1982; Martin et al., 1984; Perkins et al., 1984; Katona and Beard 1990). In the winter, whales from all populations migrate to breeding grounds in the West Indies (Balcomb and Nichols, 1982; Mattila and Clapham, 1989; Mattila et al., 1989; Katona and Beard 1990). Between these migratory end points, little is known of the distribution of the species. In recent years, however, there has been an apparent increase in the frequency of sightings of humpback whales off the mid-Atlantic coast of the United States (Swingle et al., 1993). Furthermore, a considerable number of strandings have been documented along the mid-Atlantic and southeast coasts, many in midwinter, a time when the majority of humpbacks are thought to be located in tropical waters. In this paper, we analyze data from these strandings, discuss implications regarding distribution and possible spatial segregation by age class, and examine apparent causes of mortality.

Willey, R.E., J.R. Williams, and G.D. Tasker. 1983. Hydrologic Data of the Coastal Drainage Basins of Southeastern Massachusetts, Narragansett Bay and Rhode Island Sound. Massachusetts Hydrologic-Data Report No. 25/ U.S.G.S. Openfile Report 83-145.

Abstract: Records of selected wells, test wells, borings, municipal water systems, stream flow measurements, and chemical analyses of water in the basins draining into Narragansett Bay and Rhode Island Sound.

Williams, A.B. and R.L. Wigley. 1977. Distribution of Decapod Crustacea off Northeastern United States Based on Specimens at the Northeast Fisheries Center, Woods Hole, Massachusetts. Report No. NOAA-TR-NMFS-CIRC407; NOAA-78030302 . National Marine Fisheries Service. Washington, D.C. 44 pp.

Abstract: Distributional and environmental summaries are given in an annotated checklist, supplemented by charts, graphs, and tables, for 131 species of marine decapod Crustacea found between the Gulf of Maine and near the mouth of Chesapeake Bay. The geographical area lies mainly on the continental shelf with some extension beyond this to submarine canyons and the upper continental slope. The area lies within two climate zones, which influence the distribution of decapods, cold temperate in the north and mild temperate in the south. The list is thought to be reasonably complete for benthic but not for pelagic

species. Benthic samples collected with several types of gear by vessels of the National Marine Fisheries Service (NMFS) during the past 25 yr provided the records that are charted. Data from samples on which this report is based are stored in computer files, and selected specimens are preserved in collections at the NMFS Northeast Fisheries Center, Woods Hole, Mass.

Williams, A.D. 1982. Cestode Faunal Ecology in Elasmobranch Fishes. M.S. Thesis. Southeastern Massachusetts University. North Dartmouth, MA. 134 pp.

Williams, R.G. 1969. The BIFI Oceanographic Program. USL Technical Memorandum No. 2213-84-69. U.S. Navy Underwater Sound Laboratory. New London, CT. 22 pp.

Abstract: The major objectives of the shallow water oceanography program at USL can be summarized as follows:
a. Develop a prediction model for those oceanographic variables important to underwater acoustic propagation in shallow water.
b. Investigate the physical effects of the medium on underwater acoustic transmission.
c. Intensively study a single ocean area in order to develop a generalized oceanographic model of near shore and continental shelf areas. The area selected for this study is the Block Island Sound (BIS).

The methods used in this study have included a review of all available literature, followed by an extensive experimental program. These experiments have been conducted in Block Island Sound.

Williams, R.G. 1969. Physical Oceanography of Block Island Sound. USL Report No.966. U.S. Navy Underwater Sound Laboratory. Fort Trumbull, New London, CT.

Abstract: Block Island Sound (BIS), which has a mean depth of about 40 meters, has features common to both a tidal estuary and the offshore waters of the Continental Shelf. It has access to the sea through two broad channels and access to Long Island Sound through two narrow channels. In winter, the water is well mixed and of low temperature (1°C – 3°C). In summer, a thermocline develops, such that surface temperature is 20°C, while bottom temperature may be as low as 10°C. Surface salinity is about 29.00‰ near The Race and almost 33.00‰ near Block Island. Relatively large horizontal gradients of temperature and salinity are possible in BIS. Typical winter and summer sound-velocity profiles are presented, as well as information on density, stability, optical transparency, and currents. The currents are shown to be predominantly tidal with the semidiurnal component the most important. Current speeds approach 5 knots in The Race and decreased to 0.5 knot near Block Island. The report concludes with recommendations for future research and the proposal of a measuring program that uses moored oceanographic buoys, or towers, ships, and aircraft.

Williams, R.G. 1967. The Physical Oceanography of Block Island Sound: A Review Report. USL Technical Memorandum No 2213-33-67. U.S. Navy Underwater Sound Laboratory. New London, CT. 27 pp.

Abstract: The primary objective of this study is to review and summarize the presently available literature on the oceanography of Block Island Sound in a form convenient for those desiring to perform further acoustic or oceanographic research in this area. In addition, a "quick look" analysis of some new data taken by the U.S. Coast and Geodetic Survey, Lamont Geological Observatory, the University of Connecticut and New York University may provide an idea of the variability in data taken in coastal regions. This report is in no way complete, but it is hoped that it will provide a readily available source of information on which further work can be based.

Winn, H.E. 1982. A Characterization of Marine Mammals and Turtles in the Mid- and North Atlantic Areas of the U.S. Outer Continental Shelf. Final Report of the Cetacean and Turtle Assessment Program. U.S. Dept. of the Interior, Bureau of Land Management, Washington, D.C. Contract AA551-CT-48. University of Rhode Island. Kingston, Rhode Island. 450.

Abstract: The 1982 CETAP report presents the cumulative and summarized results from field studies, which began in November of 1978 and concluded in January 1982. Program objectives were: 1) to determine which species of marine mammals and marine turtles inhabit and/or migrate through the study area; 2) to identify, delineate, and describe areas of importance (feeding, breeding, calving, *etc.*) to marine mammals and marine turtles in the study area; 3) to determine the temporal and spatial distribution of marine mammals and marine turtles in the study area; 4) to estimate the size and extent of marine mammal and turtle populations in the study area; 5) to emphasize the above items (1-4) for those species classified as threatened or endangered by the Department of Interior and Department of Commerce.

The study area was defined to be the waters overlying the U.S. Outer Continental Shelf between Cape Hatteras, North Carolina, and Nova Scotia, Canada. It is characterized by many submarine canyons, shoals, submarine banks, diverse depth gradients, proximity to a major ocean current (the Gulf Stream), numerous adjoining bays and sounds, and a large semienclosed body of water--the Gulf of Maine.

Winn, H.E., J.D. Goodyear, R.D. Kenney, and R.O. Petricig. 1995. Dive patterns of tagged right whales in the Great South Channel. Continental Shelf Research . 15(4/5):593-611.

Abstract: Right whales were tagged in 1988 and 1989 with radio and sonic telemetry tags as part of a multidisciplinary investigation of right whales and their habitat in the Great South Channel region east of Cape Cod. The tags yielded data on the durations of 6456 dives and 6482 surfacings, as well as 23,538 measurements of the depth of a diving whale. Log-survivorship analysis of the 1988 data showed a clear separation between the durations of dives between blows within a single surfacing sequence or bout (intra-bout dives) and longer dives between surfacing sequences (inter-bout dives) at 27 s, which was also applied to the 1989 data. Inter-bout dives averaged 127.3 s, and were significantly longer in 1988 than in 1989. Inter-bout dives were significantly longer during the day than night in 1988, and longer at night in 1989. The average intra-bout dive duration was 11.8 s, with 1989 dives longer than those in 1988. Surface durations averaged 6.2 s, and were also significantly longer in 1989. Dive depths were recorded only in 1989. Mean dive depth was 7.3 m, and only 12 dives went deeper than 30 m. The typical right whale dive pattern in 1988 included relatively short surfacings, long dives during the day, and shorter dives at night. This correlated with strong diel vertical migration by the dense zooplankton patches on which they were presumed to be feeding based on indirect evidence—from near the surface at night to near the bottom during the day. The 1989 pattern included longer dives during the night, as well as some exceptionally long surfacings. Zooplankton in 1989 did not migrate vertically, and remained near the surface day and night in right whale feeding areas. Right whale dive patterns in the Great South Channel are closely correlated with the horizontal and vertical distributions and movements of dense patches of their zooplankton prey.

Wishner, K., E. Durbin, A. Durbin, M. Macaulay, Winn. H., and R. Kenney. 1988. Copepod patches and right whales in the Great South Channel off New England. Bulletin of Marine Science. 43(3):825-844.

Abstract: For about a month every spring, most of the northwest Atlantic population of right whales (*Eubalaena glacialis*) is found in the Great South Channel off New England. We hypothesized that the whales aggregate in this region during the spring because of the increased abundance or aggregation of their major food item, the copepod *Calanus finmarchicus*. During a 4-day cruise in May 1986 to the Great South Channel, we located a group of surface-feeding right whales spatially associated with a large, dense, nearly monospecific concentration of copepods, primarily *C. finmarchicus*. A 200 kHz acoustic system showed that these copepods formed an extensive, nearly continuous surface layer that may have occupied an area of over 2,500 km². The copepod layer began about 20 km north of a front and extended northward at the surface in the region where water depth was deeper than 100 m. In MOCNESS plankton tows, a maximum copepod biomass of 23.6 g wet wt·m^{-3} and abundance of 41,600 copepods·m^{-3} were found, with

highest abundances in the upper 20 m. The dominant developmental stage was the copepod IV, but developmental stages from nauplius II to adult males and females were also present. The patch was a regional abundance maximum for the older developmental stages, but relative abundances of different stages changed with depth. The range of diel vertical migration of *Calanus* in the patch was small, and maximum abundances occurred near the surface day and night. The lower and side borders of the patch could be distinct and abrupt. *Calanus* abundance inside the patch was about 83 times higher than immediately below the patch and 311 times higher than immediately adjacent to the patch. Several biological and physical mechanisms, interacting with copepod behavior, may be important in the formation of the patch and the maintenance of its edges.

Witherington, B. 1994. Some "lost-year" turtles found. NOAA Tech. Memo. NMFS-SEFC-341. Pages 194-196 Schroeder, B.A. and B.E. Witherington. (Eds.), Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation. 281.

Abstract: Sea turtle hatchlings emerge from their nests, crawl down beaches, and enter the ocean to begin their pelagic "lost years" at sea. Because open-ocean research is difficult and small turtles are inconspicuous, the pelagic phase remains the central enigma of sea turtle life history. The pelagic phase has been best studied in the Atlantic loggerhead (*Caretta caretta*). Numerous second-hand accounts (Carr, 1986b) and first-hand observations (Richardson and McGillivary, 1991; Witherington, in press) record the presence of neonate loggerheads within patches of *Sargassum* offshore. Although much attention has been focused on the significance of convergence fronts and *Sargassum* to the ecology of young sea turtles (Caldwell, 1969; Carr and Meylan, 1980; Witham, 1980; Carr, 1986a), there have been no detailed studies describing how neonate turtles behave and what they encounter within these areas. The purpose of this study was to begin collecting baseline data on the behavioral ecology of pelagic neonate loggerhead turtles.

Wittman, S. 1995. Sea Grant Fisheries Bibliography. Selected Publications on Fisheries-related Issues Produced by the National Sea Grant Network 1984-1995. WISCU-L-95-005. University of Wisconsin Sea Grant Institute. Madison, WI. 58 pp.

Abstract: This bibliography is the result of a broad keyword search of all publications in the National Sea Grant Depository (NSGD) database at the University of Rhode Island's Pell Library on the URI Narragansett Bay campus. The search was limited to publications since 1984 with the keywords "fisheries," "fishery" and "Magnuson act."

Wolff, N. 1996. The Return of the American Oyster (*Crassostrea virginica*) to Narragansett Bay: Abundance and Distribution. Draft Report. Marine Ecosystem Research Laboratory, Rhode Island Sea Grant. Science Applications International Corporation (SAIC). 1989. Narragansett Bay Sediment Quality Survey, August 1988, Draft Report. SAIC Report No. 89/7553&220. Submitted to the Narragansett Bay Project.

Wood, J.D. and J.M. Côté. 2001. Historic Characterization of Hydrodynamics, Sediments, and Storm Events in Long Island Sound and Block Island Sound. Prepared for ENSR International. Applied Coastal Research and Engineering, Inc. Mashpee, MA. Various pages.

Abstract: The chapter summarizes the information available in literature concerning the hydrodynamics and sediment characteristics of Long Island Sound and Block Island Sound. In addition, a summary of historic meteorologic data with interpretation and identification of potential "worst-case" conditions in terms of potential for dredge material transport is provided. A more detailed summary of the historic worst-case storm evaluation is also attached.

Wood, J.D., J.S. Ramsey, and L.L. Weishar. 1996. Beach nourishment along Nantucket Sound: A tale of two beaches. Pages 117-129 Tait, L.S. (Ed.), The future of beach nourishment: proceedings of the 9th National Conference on Beach Preservation Technology. St. Petersburg, FL.

Abstract: Two case studies are presented analyzing the long-term performance of nourishment programs along Cape Cod barrier beaches. Dead Neck and Long Beach, located along Nantucket Sound in the town of Barnstable, Massachusetts, suffered severe erosion due largely to interruption of longshore sand transported by manmade shoreline structures. Privately funded nourishment programs were initiated for Dead Neck in 1985 and for Long Beach in 1990. The design lives of both projects were initially estimated at approximately ten years. Dead Neck was surveyed semi-annually from 1985 to 1993; Long Beach was surveyed on an approximate annual basis. The data provides a detailed history of beach profile changes at both locations. Analysis of beach profiles indicated that Dead Neck was approaching pre-nourishment conditions in April of 1993 and Long Beach may require renourishment in the coming years. This paper evaluated the nourishment programs from several perspectives. First, a detailed analysis of the beach survey data was presented to establish a long-term time series of sand volume changes at the nourished locations. These volume change estimates were then incorporated with numerical analyses of sediment transport to evaluate the use of predictive tools in augmenting beach nourishment design. In addition, the impact of major storms (both surge elevations and waves) on the short- and long-term fill performance has been included.

Wright, W.R. 1983. Nantucket Shoals Flux Experiment. Data Report I. Hydrography. NOAA Technical Memorandum NMFS-F/NEC-23. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Center.

Abstract: The Nantucket Shoals Flux Experiment (1979-1980) was a multi-institutional effort to measure the flux of shelf water along the continental shelf south of Nantucket Shoals. Cooperating institutions and principal investigators were the Northeast Fisheries Center, National Marine Fisheries Service (W. Redwood Wright); Woods Hole Oceanographic Institution (Robert E. Beardsley); U.S. Geological Survey (Bradford Butman); and the University of New Hampshire (Wendell Brown).

The fieldwork began in March 1979 and continued until April 1980. There were two principal components: 1) an array of continuously recording instruments deployed at six locations across the shelf from 44 m to 800 m depth (Figure 1), and 2) a series of cruises to measure hydrographic variables along and near the instrument line. The instrumented array included 19 current meters, most with temperature sensors, four bottom-mounted pressure and temperature sensors and one bottom tripod with current meter, camera, and nephelometer. This report presents the results of the hydrographic cruises. The data from the moored instruments are presented in Data Report II (Beardsley et al., 1983).

Yentsch, A.E., M.R. Carriker, R.H. Parker, and V.A. Zullo. 1966. Marine and Estuarine Environments, Organisms and Geology of the Cape Cod Region: An Indexed Bibliography - 1665-1965. MBL Systematics Ecology Program. Woods Hole, MA. 178 pp.

Abstract: The present volume, a second in the series, is intended as an introductory guide to the scientific literature of the region and covers a 300 year period from 1665 to 1965. It is intended to introduce scientists to major papers on the region and to provide the beginning for more intensive literature surveys. The emphasis is on works that relate to the biology of the whole organism, biotic factors of ecological significance, and physics, chemistry, climatology and geology of the region.

Yokubaitis, S.K. 1977. Bed Forms as Related to Sedimentary Processes in Block Island Sound, Rhode Island. University of Rhode Island. Kingston, RI.

Abstract: Side scan sonar is used to investigate bottom sediment activity of the inner continental shelf's Block Island off southwestern Rhode Island. Tracklines, selectively located within the three entrances of the Sound, reveal conditions of tidal current dominance within "The Race" and the western Sound, tidal

current and wave influence across the southern entrance, and wave dominance at the juncture with Rhode Island Sound.

The succession of bed forms extending eastward from "The Race" resembles sequences found in European tidal seas and appears to differ only in the lack of well-developed sand ribbons. Sand waves are ebb oriented throughout the Sound, whether located within the Sound's upper or lower flow layer. Sand which nourishes bed forms in the western Sound is derived primarily from within "The Race." Similarly, sand from the shoal west of Montauk Channel is migrating out of the Sound.

Zinn, J.A. 1970. The Orientation of Marine Recreation of Communities on Upper Buzzards Bay. URI.

Abstract: The economies of the communities of upper Buzzards Bay, Mattapoisett, Marion, Wareham, Bourne and part of Falmouth, are directly dependent on the region's summer marine recreational facilities. These towns presently reflect the variety of possible investments to be made in summer marine recreation. This economic unifying factor in the region, originating about 75 years ago, has increasingly dominated the general prosperity of the five towns. The problems resulting from this investment pattern will continue to become more acute as dependence increases.

The increasing pressures of these various commitments demonstrate the immediate need for a regional organization to plan and manage an orderly development of the area. Presently, marine recreation development at the local level is typified by fragmentation of control, procrastination for positive action, and maintenance of self-interest. At the state and federal levels, where the organization is more coherent, the upper Buzzards Bay area is very low on all priority lists for financial aid and study. The overlapping and conflicting commitments within the study region are caused mainly by the local residents' perception of the marine environment both as being static rather than dynamic and at either a personal or occasionally a community level. The thesis tested was whether a regional organization, incorporating the five towns, could benefit the local residents in their relation to the Bay by modifying their perception of the Bay to a regional concept and, consequently, manage the various summer marine recreation commitments to a regional basis.

Each town operates its segment of the shoreline in an unique manner. The first objective of this thesis was to collect the information on marine recreation in the study area. At the local level, the Annual Reports, Master Plans, and discussions with local officials showed local policies related to the marine environment. Research was also undertaken in Boston, by consulting state and federal officials interested in the marine environment. Again, interviews augmented publications of the various departments consulted. Further information was obtained in a field survey conducted in the study region to show general local feeling toward marine recreation and ways of developing it.

The second objective involved in the study was to arrive at conclusions on a more efficient way to develop the marine environment. It was readily apparent, upon assembling the available material, that this thesis should initiate discussions rather than be a conclusive work leading to action. Other proposals should be taken into consideration, the overriding consideration being that the present method of developing the marine environment must be changed in terms of control and operation.

APPENDIX B

Evaluation of Citations for Region and MPRSA Criteria Relevancy

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																	Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
A. Historical Disposal Activities																																							
Brannon, J.M.//Hoeppel, R.E. //Sturgis, T.C. //Smith, I.//Gunnison, D.	Effectiveness of Capping in Isolating Contaminated Dredged Material from Biota and the Overlying Water	1985		1											X																								X
Diaz, R.J.//Boesch, D.F.	Impact of Fluid Mud Dredged Material on Benthic Communities of the Tidal James River, Virginia	1977	Benthic; Sediment	3								VA		X																	X								
Dortch, M.S.//Halew, L.Z.////	Methods of Determining the Long-term Fate of Dredged Material for Aquatic Disposal Sites. [Microform]. Dredging Operations Technical Support Program	1990		2												X			X																				
Grigalunas, T.A.//Opaluch, J.J.//Luo, M.//Chang, Y.	Estimating Environmental Costs in Port Development: Case Study of Economic Costs to Fisheries of Marine Disposal of Clean Dredge Sediments	2001		2			X	X												X																			
Maguire Group, Inc	Evaluation of Baseline Water Column Chemistry and Sediment Resuspension Potential at Two Candidate Dredged Material Disposal Sites in Buzzards Bay	2001	Water Quality; Sediment; Phys. O	1	2000				X	X								X																					
Maguire Group, Inc.	November 2000 Baseline Characterization of Sediment Chemistry at Two Candidate Dredged Material Disposal Sites in Buzzards Bay	2001		1	2000				X									X																					
Metcalf & Eddy	Designation of Dredged Material Disposal Site(s) for Rhode Island and Southeastern Massachusetts. Task 6 - Delineate Zone of Siting Feasibility for Disposal	1987		1			X	X	X	X	X																				X								
Metcalf & Eddy	Designation of Dredged Material Disposal Site(s) for Rhode Island and Southeastern Massachusetts. Task 7. Identify Initial Screening Criteria for Sites and Methods. Prepared for U. S. Environmental Protection Agency Region 1	1987		1				X	X	X	X																													
Pratt, S.D.//Saila//Sissenwine	Dredge Spoil Disposal in Rhode Island Sound	1973	Sediment; Water Quality; Benthic; Phys. Impact	1				X				X	X	X	X				X																					
Rhode Island Marine Trade Assoc.//Daniel S. Natchez & Associates, Inc.	The Need for and Economic Impact of an Open Water Disposal Site for Dredged Materials for the Coastal Rhode Island Water Dependent Marine Industries 1985	1985	Economic Impacts	1				X											X																				
Ruggaber, G.J.//Adams, E.E.	Dynamics of Particle Clouds Related to Open-water Sediment Disposal.	2000	Sediment	2											X																								
SAIC	Buzzards Bay Disposal Site Baseline Study, March 1990 Disposal Area Monitoring System DAMOS	1991	Phys. O; Benthic	1	3/27/90-3/29/90				X				X	X				X					X			X													
SAIC	Rhode Island and Southeastern Massachusetts Dredging Needs Survey 1985-1995	1985		1														X		X																			
Saila, S.B.//Pratt, S.D.//Polgar, T.T.	Providence Harbor Improvement Spoil Disposal Site Evaluation Study: Phase II	1971	Phys. O; Sediment; Fisheries; Benthic	1	1967-1970		X	X											X	X								X										
Swanson, J.C.//Mendelsohn, D.	Velocity Estimates for Candidate Dredged Material Disposal Sites in Narragansett Bay. Submitted to Science Applications International Corporation and New England District, U. S. Army Corps of Engineers	1998	Phys. O	2			X									X																							
Thompson, B.P.	Evaluation of the U.S. Army Corps of Engineers' Decision-making Process for Selection of Dredged Material Disposal Sites	1985		2																																			X
U.S. Army Corps of Engineers	Inventory of Dredging Needs in the Designated Port Areas of Massachusetts 1996-2016.	1996		1																																			
U.S. Army Corps of Engineers	Long Island Sound Dredged Material Disposal Environmental Impact Statement. Dredging Needs Navigation-Dependent Facilities	2001		1																																			
U.S. Army Corps of Engineers	Preliminary Field Operations in Support of Disposal Site Designation in the Rhode Island Sound Region: Disposal Area Monitoring System DAMOS	1990	Phys. O; Sediment; Benthic	1				X					X	X	X			X																					

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																			Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
U.S. Army Corps of Engineers	Providence Harbor and River Maintenance Dredging Project Final Environmental Impact Statement	2001	Phys. O; Water Quality; Sediments; Fisheries; Benthic; Archaeology; Endangered Species	1			X	X																	X															
U.S. Army Corps of Engineers	Rhode Island Sound Regional Disposal Site Study: Rhode Island and Southeastern Massachusetts Dredging Needs Survey:1985-1995	1985		2	1985	X	X	X	X	X	X							X		X												X							
U.S. Army Corps of Engineers	The National Dredging Needs Study of Ports and Harbors. [Microform]. Literature Search. Prepared by DRI/McGraw-Hill	1995		2																																			
B. Physical Oceanographic Data and Investigations																																							
	CURRENTS/CIRCULATION																																						
Asselin, S.//Spaulding, M.L.	Flushing Times for the Providence River Based on Tracer Experiments	1993		1	1988-1989		X								X																				X				
Briggs, S.//Southard, J.B.	Tidal-current Sand Waves in Vineyard Sound, Massachusetts	1980	Sediment	2						X																													
Butman, B.//Signell, R.//Shoukimas, P.//Beardsley, R.C.	Current Observations in Buzzards Bay, 1982-1986. Data Report	1988		1	1982-1986				X								X	X																	X	X			
Cook, G.S.	Non-tidal Circulation in Rhode Island Sound; Drift Bottle and Sea-bed Drifter Experiments (1962-1963)	1966		2	1962-1963		X	X										X		X																				
French, D.//Rines, H.//Boothroyd, J.//Galagan, C.//Gould, M.// Villalard-Bohnsack, M.//Gould, L. //Steere, L.//Porter, S.	Final Report: Habitat Inventory/Resource Mapping for Narragansett Bay and Associated Coastline. Volumes I-IV, Atlas and Maps. Report to Narragansett Bay Project, Providence, RI	1992	Sediment; Water Quality; Benthic; Fisheries	1			X						X	X				X										X	X			X		X	X				
Geyer, W.R.//Signell, R.	Measurements of Tidal Flow Around a Headland with a Shipboard Acoustic Doppler Current Profiler	1990		1						X							X															X						
Haight, F.J.	Currents in Narragansett Bay, Buzzards Bay, and Nantucket and Vineyard Sounds. 2nd ed., revised	1938		1	1936		X		X	X	X			X					X			X									X	X					
Higgins, B.J.	Surface Circulation of Nantucket Sound as Determined by Drifters	1972		1	1972						X					X						X									X						
Krabach, M.H.//Snooks, J.H.	Coastal Zone Flushing Characteristics, NEP 1 & 2, Charlestown, Rhode Island	1977		2 or 3	1974	X							X					X																			
Miller, J.E.//Ferguson, J.S.//Byrne, J.S.	Use of an Integrated Hydrographic Survey System in Long Island Sound and Vineyard Sound	1996		3						X			X																									
Miller, J.E.//Ferguson, J.S.//Byrne, J.S.//Simmons, W.S.	Shallow Water Multibeam Hydrography to IHO Standards	1996		3	1995					X							X																					
National Ocean Survey	Block Island Sound and Eastern Long Island Sound; Tidal Current Charts. 1st ed	1971		2		X								X																				X				
NOAA Sea Grant	Model-predicted Tidal Current Charts, Long Island Sound to Buzzards Bay	1979		2		X		X	X	X		X					X																	X	X			
Pilson, M.E.Q.	On the Residence Time of Water in Narragansett Bay	1985		1			X										X																	X				
Powers, C.F.	Circulation in the Newport Bight - Block Island Sound - New York Bight Area	1953		1	1951	X		X		X							X																					
Pratt, S.D.//Griscom, C.A.//Heavers, R.A.	Survey of Currents, Water Turbidity, and Benthic Biology in the Vicinity of Browns Ledge, Rhode Island Sound	1975	Benthic; Water Quality	1	1974			X				X	X	X			X									X							X	X				
Riley, G.A.//Deevey, G.B.//Merriman, D.//Sclar, R.//Sander, H.L.	Hydrography and Biological Studies of Block Island Sound	1952		2	1946-1950	X						X	X	X																									
Rosenfeld, L.K.//Signell, R.P.//Gawarkiewicz, G.	Hydrographic Study of Buzzards Bay, 1982-1983.	1984	Water Quality	1					X					X																						X			
Snow, W.B.//Hoff, H.B.//Markham, J.J.	Transmission Survey of Block Island Sound	1944		3		X											X																					
U.S. Army Corps of Engineers	DAMOS Disposal Area Monitoring System Annual Data Report - 1978; Supplement E Brenton Reef Disposal Site	1979	Sediment; Fisheries; Benthic	1				X						X				X		X																			

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria														Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
U.S. Coast and Geodetic Survey	Tidal Current Charts, Torpedo Range, Block Island Sound	1943		2	1943	X														X			X								X	X				
U.S. Dept. of Commerce	Tidal Current Charts, Long Island Sound and Block Island Sound. 4th ed	1958		1		X												X		X																
Willey, R.E.//Williams, J.R.//Tasker, G.D.	Hydrologic Data of the Coastal Drainage Basins of Southeastern Massachusetts, Narragansett Bay and Rhode Island Sound	1983		3	1972-1974		X	X									X																		
Weisberg, R.H.//Sturges, W.	Velocity Observations in the West Passage of Narragansett Bay: A Partially Mixed Estuary	1976		1			X							X																					
	WAVES																																			
Hicks, S.E.//Frazier, D.E.//Taylor, A.P.	Wind Wave Characteristics of Rhode Island Water	1956		1	1954	X	X	X												X																
Patton, K.T.	Prediction of Wind Waves in Block Island Sound	1969		2		X										X																				
Rank, P.H.//Grosch, C.E.//Lukasik, S.J.//Zepko, G.W.	The Directional Swell Spectrum off Block Island	1967		3		X								X	X																				
Swanson, C.//Spaulding, M.	Nearshore Wave Climate for Block Island Sound	1977		2		X		X						X												X									
	BATHYMETRY/TOPOGRAPHY																																			
Barnes, J.R.	Magnetic Investigations of Block Island Sound	1973		3		X																				X									
Bowman, M.J.//Esaias, W.E.	Fronts, Stratification, and Mixing in Long Island and Block Island Sounds	1981		1	1978	X						X					X															X			
Gallagher, J.//Nalwalk, A.	Bathymetry of Block Island Sound	1971		2		X																											X			
Ichiye, T.	Tidal Variation of Hydrography of Block Island Sound Observed in August 1965	1967		2	1965	X								X		X																				
Maguire Group, Inc.	Results of the October 2000 Bathymetric Survey at Candidate Disposal Site 1 in Buzzards Bay	2001	Historic	1	1998				X					X				X																		
	TEMPERATURE																																			
Armstrong, R.S.	Water Temperatures and Climatological Conditions, South of New England, 1974-83	1998	Water Quality	1	1974-1983			X		X		X					X																			
Ayers, J.C.//Crawford, R.W.	The Distribution of Temperature in the Waters of Long Island Sound, Block Island Sound and Newport Bight. Cruise STIRNI - III, January - February 1952	1953	Water Quality	1	Jan 1952 - Feb. 1952	X								X					X																	
Day, C.G.	Bottom Water Temperature on Browns Ledge off Southern Massachusetts	1960		2	1959				X								X																X			
Driscoll, E.G.	Oxygen, Salinity, pH, and Temperature Variations in the Bottom Water of Buzzards Bay	1972	Water Quality	2	1971-1972				X					X																						
Snooks, J.H.//Kramer, W.P.	Summary of Temperature and Salinity Observations in Block Island Sound during July 1975 through September 1976	1977	Water Quality	3	7/75-9/76	X												X		X																
	SEDIMENT TRANSPORT																																			
Aubrey, D.G.//Goud, M.R.	Coastal sediment transport, Popponesset Beach, MA	1983	Sediment	2							X		X																							
Hubertz, J.M.	Variation of measured meteorologic and oceanic variables off the U.S. Atlantic coast: 1980-1994	1995		3																																
Wood, J.D.//Ramsey, J.S.//Weishar, L.L.	Beach nourishment along Nantucket Sound: a tale of two beaches	1996	Sediment	2							X						X																			
	OTHER																																			
Aubrey, D.G.	Proceedings of a Workshop on Coastal Zone Research Held at Woods Hole, Massachusetts on November 27-28, 1978.	1979		2								MA																								
Bowman, M.J.//Esaias, W.E.//Schnitzer, M.B.//Mirchel, H.G.	Cruise Data Report, R/V Ridgely Warfield, Long Island and Block Island Sounds, September 13-21, 1978	1979	Sediment	1		X								X																						
Bumpus, D.F.//Lynde, R.E.//Shaw, D.M.	Physical Oceanography	1973		1		X	X	X	X	X	X	X	X																				X			
Chinman, R.A.//Nixon, S.W.	Depth-area-volume Relationships in Narragansett Bay	1985		3			X											X																		
Deaver, J.W.	Aerial Oceanographic Observations, July 1969-June 1970, Cape Cod Massachusetts to Miami, Florida	1975		1													X																			
Friedrich Neff, N.//Lewis, R.S.	Non-energy Resources, Connecticut and Rhode Island Coastal Waters	1989		2		X						X		X																						
Hicks, S.D.	The Physical Oceanography of Narragansett Bay	1959	Water Quality	2	1951-1956		X							X	X			X						X										X		
Pratt, S.D.//Heavers, R.M.	Background Turbidity Conditions of Rhode Island Sound and Buzzards Bay	1975		2			X	X	X					X																			X	X		
Williams, R.G.	Physical Oceanography of Block Island Sound	1969		1		X								X																						

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																	Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Williams, R.G.	The BIFI Oceanographic Program	1969	Sediment	3		X																																	
Williams, R.G.	The Physical Oceanography of Block Island Sound: A Review Report	1967		2		X														X																			
C. Sediment Data and Investigations																																							
Battelle//SAIC	Sediment Profile Sampling for the Providence River and Harbor, Final EIS	2000	Benthic	1	1996-1999			X					X	X														X								X			
Bertoni, R.S.	Geological and Geophysical Investigation of Block Island Sound between Fishers and Gardiners Islands	1974		3	1971-1973	X														X							X											
Boothroyd, J.C.//Dacey, M.F.//Rosenberg, M.J.	Geological Aspects of Shoreline Management: A Summary for Southern Rhode Island. I. Regional Depositional Systems and a Long-term Profiling Network.	1986		3																																		
Boothroyd, J.C.//Galagan, C.W.//Graves, S.M.	Advance and Retreat of the Southern Rhode Island Shoreline, 1939-1985; Including 1985 Berm Volume	1986	Phys. O; Geology	3	1939-1985	X														X							X				X							
Bricker, S.B.	The History of Metals Pollution in Narragansett Bay as Recorded by Salt Marsh Sediments	1990		3		X	X							X						X																		
Briggs, S.R.//Rubin, D.M.//Southard, J.B.	Spatial Variations in Sand-wave Size and Migration Rate; Implications for Shoal Dynamics	1981		2						X								X																				
Brown, B.//Neff, J.	Bioavailability of Sediment-bound Contaminants to Marine Organisms	1993	Benthic	2									X																										
Butman, B.	Physical Processes Causing Surficial-sediment Movement, in Georges Bank	1987		3	1982-1986				X								X	X																		X	X		
Calabro, R.B.	Coastal Geologic Hazards and Future Shoreline Change, Southern Rhode Island Shoreline: Implications for Management	1997		3										X					X	X																		
Cole, D.L.	Commentary on Narragansett Bay Sediments	1956		3			X						X	X																									
Connolly, J.P.//St. John, J.P.	Application of a Mathematical Food Chain Model to Evaluate Remedial Alternatives for PCB-contaminated Sediments in New Bedford Harbor, Massachusetts: Superfund '88	1988	Water Quality; Fisheries; Benthic	2										X		X																							
Corbin, J. M.	Recent and Historical Accumulation of Trace Metal Contaminants in the Sediment of Narragansett Bay, Rhode Island. Masters Thesis	1989		1			X							X						X																		
Cornillon, P.	A Nearshore Sediment Resuspension Study in the Waters of Block Island Sound / Submitted to Yankee Atomic Electric Company, Westboro, Massachusetts	1979		3		X								X																								
Danbom, S.H.	Sediment Classification by Seismic Reflectivity in Eastern Block Island Sound	1975		1		X								X						X															X			
Daskalakis, K.D.//O'Connor, T.P.	Inventory of Chemical Concentrations in Coastal and Estuarine Sediments. [Microform]	1994		2													X																					
Dein, M.G.	A Quantitative, Photogrammetric Analysis of Narragansett Bay, Rhode Island Shoreline Changes, 1938-1975	1981	Beach Erosion	3			X																																
Dietz, F.T.//Mulholland, C.V.//Birch, W.B.	A Direct Measurement of Sound Velocities in Narragansett Bay Sediments	1958		3	1956		X							X																								
Donohue, J.J.	Marine Sedimentation Project Annual Report, 31 August 1952 - 30 August 1953	1954		3																																		
Driscoll, N.	Scientists Study Large Storm and Human Effects in Block Island Sound	1996		2		X													X																			
Ely, E.//Crist, D.T.	Narragansett Bay Window: The Cooperative Bay Program Phase 1	2000	Water Quality; Fisheries	2			X																																Note: General Info maybe link to Data
Emerson, D.J.	The Monitoring of Clostridium perfringens Spore Density in Bottom Sediments and its Applications	1982	Water Quality	2			X							X	X																							
Frey, R.W.//Howard, J.D.//Dörjes, J.	Coastal Sediments and Patterns of Bioturbation, Eastern Buzzards Bay, Massachusetts	1989	Historic Disposal	1					X									X	X																	X			
Gautie, S.C.	Geomorphology of the Southern Rhode Island Shoreline in Relation to Erosion and Accretion Characteristics	1977	Beach Erosion	3														X																					
Germano, J.//Rhoads, D.	Narragansett Bay Sediment Quality Survey, August 1988. Submitted to the Narragansett Bay Project	1989	Water Quality; Benthic	2	1988			X					X	X																									

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																		Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Gibeaut, J.C.	Geological Aspects of Shoreline Management: A Summary for Southern Rhode Island I. Regional Depositional Systems and a Long-term Profiling Network. Vol. 1A. Plotted Profiles	1986		3																																		
Graves, S.M.	Morphotomology of Rhode Island Barrier Shores: A Method of Distinguishing Beach from Dune/Barrier Component Histories within a 29 year Record of Shore Zone Profile Data, with Special Reference to the Role of the Beach as a Buffer and Modulator [sic] of Erosional Coastline Retreat	1990	Beaches	3																																			
Hinga, K.R.	Contaminated Sediments in Narragansett Bay: Severity and Extent	1992		2			X							X	X				X																				
Hurtt, A.C.	The Distribution of Hydrocarbons in Narragansett Bay Sediment Cores	1978		2			X							X																									
Johnson, R.C.	Particulate Matter at the Sediment-Water Interface in Coastal Environments	1974		2										X																									
Keith, D.J.//Davis, W.R.//Paul, J.F.	Sediment Erodibility in Narragansett Bay, Rhode Island: A Method of Predicting Sediment Dynamics	1991		1	1988-1989		X							X	X	X																							
King, J.////	A Study of the Sediments of Narragansett Bay : Volume I. The Surface Sediments of Narragansett Bay. Final Report Submitted to the Narragansett Bay Project	1995		2			X						X	X	X																								
Knebel, H.J.//Needal, S.W//O'Hara, C.J.	Modern Sedimentary Environments on the Rhode Island Inner Shelf, off the Eastern United States	1982	Phys. O	2		X		X										X																				
Latimer, J.S//Davis, W.R//Keith, D J	Mobilization of PAHs and PCBs from in-place Contaminated Marine Sediments during Simulated Resuspension Events	1999		3			X								X																							
Long, E.R.//Morgan, L.G.	The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program	1990		3			X																															
Macilvaine, J.	Sedimentary Processes on the Continental Slope off New England. Ph.D. Thesis	1973		3																																		
McGetchin, T.R.	Bottom Sediments and Fauna of Western Narragansett Bay, Rhode Island	1961		3			X																															
McMaster, R.L.	Sediments of Narragansett Bay Systems and Rhode Island Sound Rhode Island	1960		1			X	X						X																								
McMaster, R.L.//Clarke, W.B.	A Survey of Bottom Surface Sediments in Upper Narragansett and Mt. Hope Bays	1956	Benthic; Fisheries	1	1986-1987		X							X																								
McMaster, R.L.//Garrison, L.E.	A Submerged Holocene Shoreline Near Block Island, Rhode Island	1967		1	To 1966	X		X						X				X																				
McMaster, R.L.//Lachance, T.P.//Garrison, L.E.	Seismic-reflection Studies in Block Island and Rhode Island Sounds	1968		1	1965-1966	X		X						X				X		X																		
Miller, G.R.	A Survey of the Available Information on Toxic Materials in Narragansett Bay	1974	Water Quality; Fisheries; Benthic	1			X						X																									
Morang, A.	Nearshore Sedimentary Processes and Circulation along the Southwestern Rhode Island Shoreline based on Side-scan Sonar Surveys	1978	Phys. O; Circulation; Tidal Patterns	1	Apr - Dec 1977	X							X					X		X																		
Morang, A.//McMaster, R.L.	A Study of Nearshore Processes along the Southwestern Rhode Island Shoreline based upon Side Scan Sonar Surveys: Final Report, Coastal Resources Management Council, State of Rhode Island	1978	Phys. O	2	1977-1978									X																									
Morton, R.W.	Spatial and Temporal Observations of Suspended Sediment: Narragansett Bay and Rhode Island Sound	1967	Water Quality	1	1965-1966		X	X						X					X																				
Munns, W.R. =, Jr.////	Marine Ecological Risk Assessment at Naval Construction Battalion Center, Davisville, Rhode Island, Phase I	1991	Water Quality; Benthic	3			X					X	X		X			X	X																				
Nixon, S.W.//Lee, V.	Spatial and Temporal Pollution Gradients in Narragansett Bay	1979		3			X							X	X		X	X																				
O'Connor, T.P.	Coastal Environmental Quality in the United States, 1990: Chemical Contamination in Sediment and Tissues	1990	Fisheries	3		X	X		X				X							X																		
O'Hara, C.J.	High-resolution Seismic-reflection Profiling Data from the Inner Continental Shelf of Southeastern Massachusetts	1980		2	1975			X		X																												

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																	Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
O'Hara, C.J.	Side-scan Sonograph Data from Eastern Rhode Island Sound and Vineyard Sound, Massachusetts	1980		3	1980			X		X				X																								
O'Hara, C.J.//Oldale, R.N.	Marine Geologic Studies of the Inner Continental Shelf off Massachusetts	1982		2																																		
Oviatt, C.A.//Nixon, S.W.	Sediment Resuspension and Deposition in Narragansett Bay	1975		1			X							X																								
Petti, M.J.	Phosphorus Exchange at the Sediment-water Interface of Selected Narragansett Bay Sediments	1975		3			X							X																								
Pruell, R.J.//Quinn, J. G.	Geochemistry of Organic Contaminants in Narragansett Bay Rhode Island USA Sediments	1985		1			X							X																								
Regan, D.R.	An Aerial Photogrammetric Survey of Long-term Shoreline Changes, Southern Rhode Island Coast	1976	Phys. O; Shoreline Changes	1	1939-1972	X														X																		
Rhoads, D.C.	Biogenic Reworking of Intertidal and Subtidal Sediments in Barnstable Harbor and Buzzards Bay, Massachusetts, USA	1967	Benthic	2					X					X																								
Rhoads, D.C.//Boyer, L.F.	The Effects of Marine Benthos on Physical Properties of Sediments: A Successional Perspective	1982	Water Quality	2												X																						
Rosenberg, M. J.	Geological Aspects of Shoreline Management: A Summary for Southern Rhode Island. II. Temporal Variability of Beach Profiles, Charlestown Beach, Rhode Island. Vol. 2	1986		3																																		
Savard, W.L.	The Sediments of Block Island Sound. Master's Thesis	1966		1		X								X						X																		
Sheih, M.S.J.	Nutrients in Narragansett Bay Sediments	1974		2			X							X	X					X																		
Simpson, E.J.	A Photogrammetric Survey of Backbarrier Accretion on the Rhode Island Barrier Beaches	1977		3																																		
Snelgrove, P.V.R.	Importance of Fine-scale Flow Processes and Food Availability in the Maintenance of Soft-sediment Communities. Doctoral Thesis	1993	Benthic	3																																		
Teal, J.M.//Farrington, J.W.//Burn, K.A.//Stegeman, J.J.//Tripp, B.W.//Woodin, B.//Phinney, C.	The West Falmouth Oil Spill After 20 years: Fate of Fuel Oil Compounds and Effects on Animals	1992		3	1989				X										X																		
U.S. Environmental Protection Agency, Sediment Oversight Technical Committee	Managing Contaminated Sediments [Microform]. EPA Decision-making Processes	1990	Dredged Material; Federal EPA Guidance	2																																		
Wade, T.L.	Sedimentary Geochemistry of Hydrocarbons from Narragansett Bay, Rhode Island; Incorporation, Distribution, and Fate	1978		2			X							X																								
Wood, J.D.//Côté, J.M.	Historic Characterization of Hydrodynamics, Sediments, and Storm Events in Long Island Sound and Block Island Sound. Prepared for ENSR International	2001	Phys. O	1		X						X	X						X			X			X				X								
Wright, W.R.	Nantucket Shoals Flux Experiment	1983	Phys. O	1	1979-1980						X	X		X																								
Yentsch, A.E.//Carriker, M.R.//Parker, R.H.//Zullo, V.A.	Marine and Estuarine Environments, Organisms and Geology of the Cape Cod Region: An Indexed Bibliography - 1665-1965	1966	Fisheries	2					X	X	X									X																		
Yokubaitis, S.K.	Bed Forms as Related to Sedimentary Processes in Block Island Sound, Rhode Island	1977	Phys. O	1 or 2		X								X																X								
	Marine Sedimentation Project Progress Report, 31 August 1953 - 28 February 1954	1954	Phys. O	3			X			X				X	X																							
	Marine Sedimentation Project, Progress Report, 1 March 1955 - 31 August 1955	1955	Phys. O	3			X							X	X																							
	Marine Sedimentation Project, Progress Report, 1 September 1954 - 28 February 1955	1955		3																																		
D. Water Quality Data and Investigations																																						
Blumer, M.//Sass, J.//Souza, G.//Sanders, H.L.//Grassle, J.F.//Hampson, G.R.	The West Falmouth Oil Spill: Persistence of the Pollution Eight Months after the Accident. Technical Report Submitted to the Office of Naval Research	1970	Sediment; Fisheries	2	1970				X										X	X																		
Brubaker, K.L.//Byrne, J.	Zero Tolerance: Reducing Toxic Pollution in Narragansett Bay	1989		3			X																															
Campbell, J.W.//O'Reilly, J.E.	Role of Satellites in Estimating Primary Productivity on the Northwest Atlantic Continental Shelf	1988		3	1977-1982																																	

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Coastal Services Center	NBNERR Data Recovery Project [Computer Laser Disk]	1998	Fisheries; Benthic; Public Parklands	1			X														Yes							X							X	
Crawford, R.W.	The Distribution of Oxygen in the Waters of New York Bight, Block Island Sound, and Newport Bight: Cruise STIRNI-I, July - September 1951	1952		3	1951	X		X	X	X				X						X																
Desbonnet, A.//Lee, V.	Historical Trends: Water Quality and Fisheries Narragansett Bay	1991	Fisheries	2			X													X																
Deubler, E.T.//Ayers, J.C.	A Winter Survey of Oxygen Distribution in Long Island Sound and Block Island Sound: Cruise STIRNI-III, January - February 1952	1953	Phys. O	3	1952	X								X						X																
Feld, S.//Rorholm, N.	Economic Growth and the Generation of Waterborne Wastes	1973		3			X									X																				
Fox, M.F.//Kester, D.R.//Andrews, J.E.//Magnuson, A.//Zoski, C.G.	Seasonal Warming of Narragansett Bay and Rhode Island Sound in 1997: Advanced Very High Resolution Radiometer Sea Surface Temperature and In situ Measurements	2000	Phys. O	1	1997		X	X	X								X																			
Howes, B.L.//Goehringer, D.	Ecology of Buzzards Bay: An Estuarine Profile	1996	Benthic	2					X				X																								
Howes, B.L.//Williams, T.//Rasmussen, M.	Baywatchers II: Nutrient Related Water Quality of Buzzards Bay Embayments: A Synthesis of Baywatchers Monitoring 1992-1998	1999		1	1992-1998				X								X																			
Kadri, J.	A Raw Deal: Combined Sewer Overflow Pollution in Narragansett Bay	1991		3			X																														
Li, Y.//Smayda, T.J.	Temporal Variability of Chlorophyll in Narragansett Bay, 1973-1990	1998		2	1973-1990		X							X			X																		X	
McMaster, R.L//Ashraf, A.	Extent and Formation of Deeply Buried Channels on the Continental Shelf off Southern New England	1973	Sediment	3		X								X																							
Narragansett Bay Project	The Narragansett Bay Project Progress Report: Pollutant Trends in Narragansett Bay	1989	Sediment; Fisheries	2	1985-1986		X																														
Nixon, S.W.	Prehistoric Nutrient Inputs and Productivity in Narragansett Bay	1997	Benthic	2			X									X				X																
Pilson, M.E.Q.	Annual Cycles of Nutrients and Chlorophyll in Narragansett Bay, Rhode Island	1985		2	1977-1982		X							X			X	X	X																X	
Pilson, M.E.Q.//Hunt, C.D.	Water Quality Survey of Narragansett Bay, A Summary of Results from SINBADD 1985-1986	1989		1	1985-1986		X							X				X																	X	
Rhode Island Department of Environmental Management	Narragansett Bay Water Quality: Status and Trends 2000	2000		1	1953-1995		X						X																						X	
Stenner, T.W.//Gulbransen, T.G.//Baptiste, E.M.	Water Quality Data Assessment for Buzzards Bay: Coliform and Nutrients	1988		1	1972-1987				X								X		X																X	
E. Fisheries/Shellfisheries Data and Investigations																																						
	WINTER FLOUNDER																																					
Atlantic States Marine Fisheries Commission	Assessment of the Southern New England/Mid-Atlantic and Gulf of Maine Winter Flounder Stocks	1998		3	Dec. 1997							X		X		X																				
Buckley, L.J.//Smigielski, A.S.//Halavik, T.A.//Caldarone, E.M.//Burns, B.R.//Laurence, G.C.	Winter Flounder Pseudopleuronectes americanus Reproductive Success. 1. Among-location Variability in Size and Survival of Larvae Reared in the Laboratory	1991		3	1987-1988		X					X		X	X																					
Buckley, L.J.//Smigielski, A.S.//Halavik, T.A.//Caldarone, E.M.//Burns, B.R.//Laurence, G.C.	Winter Flounder Pseudopleuronectes americanus Reproductive Success. 2. Effects of Spawning Time and Female Size on Size, Composition and Viability of Eggs and Larvae	1991		3			X							X	X																					
Callaghan, D.W.//Comerford, R.A.	The Economic Impact of Commercial Fishing on the State of Rhode Island, 1975. Submitted to the Rhode Island Governor's Task Force on Fisheries	1978		1	1975			X											X															X		
Casterlin, M.E.//Reynolds, W.W.	Thermoregulatory Behavior and Diel Activity of Yearling Winter Flounder, Pseudopleuronectes americanus (Walbaum)	1982		2	1979										X							X					X								
Collier, T.K.//Anulacion, B.F.//Bill, B.D.	Hepatic CYP1A in Winter Flounder (Pleuronectes americanus) along the Northeast Coast: Results from the National Benthic Surveillance Project	1998		2	1988-1994		X							X																					

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria												Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Connolly, J.P.	Application of a Food Chain Model to Polychlorinated Biphenyl Contamination of the Lobster and Winter Flounder Food Chains in New Bedford Harbor	1991		3					X							X																		
Crawford, R.E.//Carey, C.G.	Retention of Winter Flounder Larvae within a Rhode Island Salt Pond	1985	Phys. O	3	Mar. 1981 - Apr. 1981							X		X		X													X						
Delong, A.K.//Collie, J.S.//Meise, C.J.//Powell, J.C.	Estimating Growth and Mortality of Juvenile Winter Flounder, Pseudopleuronectes americanus, with a Length-based Model	2001		3	1988-1998		X							X		X																		
Elskus, A.A.//Pruell, R.//Stegeman, J.J.	Endogenously-mediated, Pretranslational Suppression of Cytochrome P4501A in PCB-contaminated Flounder	1992		3				X				X		X	X																			
Elskus, A.A.//Stegeman, J.J.//Gooch, J.W.//Black, D.E.//Pruell, R.J.	Polychlorinated Biphenyl Congener Distributions in Winter Flounder as Related to Gender, Spawning Site, and Congener Metabolism	1994		3				X	X					X	X																			
Gray, C.L.	Winter Flounder (Pseudopleuronectes americanus) Species Profile	1991		1		X	X	X										X			X							X						X	
Grimes, B.H.//Huish, M.T.//Kerby, J.H.//Moran, D.	Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) Summer and Winter Flounder	1989		2	1989			X		X	X	X						X																
Grove, C.A.	Population Biology of the Winter Flounder, Pseudopleuronectes americanus, in a New England Estuary. Master's Thesis	1982		3												X																		
Howe, A.B.//Coates, P.G.	Winter Flounder Movements, Growth, and Mortality off Massachusetts	1975		1	1960-1971				X	X	X	X						X			X							X						X	
Howe, A.B.//Coates, P.G.//Pierce, D.E.	Winter Flounder Estuarine Year-class Abundance, Mortality and Recruitment	1976		2						X	X			X																				
Hughes, J.B.	Cytological-cytogenetic Analyses of Winter Flounder Embryos Collected from the Benthos at the Barge North Cape Oil Spill	1999		2										X					X										X						
Jeffries, H.P. //Johnson, W.C.	Seasonal Distribution of Bottom Fishes in the Narragansett Bay Area: Seven Year Variations in the Abundance of Winter Flounder (Pseodopleuornectes americanus)	1974		2	1966-1972		X	X						X																				
Johnson, L.L.//Stein, J.E.//Collier, T.K.//Casillas, E.//McCain, B.//Varanasi, U.	Bioindicators of Contaminant Exposure, Liver Pathology, and Reproductive Development in Prespawning Female Winter Flounder (Pseudopleuronectes americanus) from Urban and Nonurban Estuaries on the Northeast Atlantic Coast	1992		2	1988-1989							X							X																
Keller, A.A.//Klein-MacPhee, G.	Impact of Elevated Temperature on the Growth, Survival, and Trophic Dynamics of Winter Flounder Larvae: A Mesocosm Study	2000		2	1997		X								X																			
Lee, T.C.//Saila, S.B///Wolke, R.E.	Winter Flounder Contaminant and Pathological Survey: Narragansett Bay and Vicinity	1991		2	1990		X							X	X				X															
Lloyd, David E	Application of Hepatic Macrophage Aggregates as Health Monitors of Narragansett Bay Winter Flounder, Pseudopleuronectes americanus	1988		3			X																											
MacLean, S.A.	Pathological Conditions of Narragansett Bay Young-of-the-year Winter Flounder	1993		1	1990		X							X																				
Meng, L.//Gray, C.//Taplin, B.//Kupcha, E.	Using Winter Flounder Growth Rates to Assess Habitat Quality in Rhode Island's Coastal Lagoons	2000		3										X																				
Meng, L.//Powell, J.C.//Taplin, B.	Using Winter Flounder Growth Rates to Assess Habitat Quality across an Anthropogenic Gradient in Narragansett Bay, Rhode Island	2001		2	1998		X							X																				
Pearcy, W.G	Ecology of an Estuarine Population of Winter Flounder, Pseudopleuronectes americanus (Walbaum). Parts I-IV	1962		3								X																						
Pereira, J.J.//Goldberg, R.//Ziskowski, J.J. //Berrien, P.L. //Morse, W.W.// Johnson. D.L.	Essential Fish Habitat Source Document: Winter Flounder, Pseudopleuronectes americanus, Life History and Habitat Characteristics	1999		1													X																		
Pierce, D.R.//Howe, A.B.	A Further Study on Winter Flounder Group Identification off Massachusetts	1977	Fisheries	2	1969-1971				X	X	X	X						X			X														
Powell, J.C.	Winter Flounder Spawning Characteristics and Habitat Requirements	1989		1				X	X								X				X							X						

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria												Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Powell, J.C.	Winter Flounder Tagging Study, 1986-1988, with Comments on Movement	1989		1													X					X						X						
Rose, K.A.//Tyler, J.A.//Chambers, R.C.//Klein-MacPhee, G.//Danila, D.J.	Simulating Winter Flounder Population Dynamics using Coupled Individual-based Young-of-the-year and Age-structured Adult Models	1996		2												X																		
Smith, R.M.//Cole, C.F.	Effects of Egg Concentrations of DDT and Dieldrin on Development in Winter Flounder (Pseudopleuronectes americanus)	1973		3											X																			
	LOBSTER																																		
Angell, T.E.//Olszewski, S.D.	Rhode Island Lobster Research and Management Project - February 1, 1997 - January 31, 2000 period covered and project duration.	2000		1	1997-2000		X	X				Offshore Hudson Canyon		X				X				X							X						
Cadrin, S.X.	Discrimination of American Lobster (Homarus americanus) Stocks off Southern New England on the Basis of Secondary Sex Character Allometry	1995		3					X			X		X																				
Castro, K.M.//Angell, T.E.	Prevalence and Progression of Shell Disease in American Lobster, Homarus americanus, from Rhode Island Waters and the Offshore Canyons	2000		2	1995-1999	X																													
Cobb, J.S.//Castro, K.//Wahle, R.//Catena, J.	An Artificial Reef for Lobsters (Homarus americanus) in Rhode Island, USA	1998		3	1997	X	X					X		X								X							X						
Cobb, J.S.//Clancy, M.//Wahle, R.A.	Habitat-based assessment of lobster abundance: a case study of an oil spill	1999		1	2/28/96-9/30/96			X						X			X					X							X				X	X	
Cobb, J.S.//Wang, D.//Campbell, D.B.	Timing of Settlement by Postlarval Lobsters Homarus-americanus Field and Laboratory Evidence	1989		2	1985-1987										X														X						
Cobb, S.//Gulbransen, T.//Phillips, B.F.//Wang, D.//Syslo, M.	Behavior and Distribution of Larval and Early Juvenile Homarus americanus	1983		1					X			X		X															X						
Cooper, R.A.//Uzmann, J.R.	The Biology and Management of Lobsters Vol. II Ecology and Management	1980		2														X																	
Elner, R.W.//Hamet, S.L.	The Effects of Ocean Dumping of Dredge Spoils onto Juvenile Lobster Habitat: A Field Evaluation	1984	Historic Disposal	2										X					X																
Estrella, B.T.	Black Gill and Shell Disease in American Lobster (Homarus americanus) as Indicators of Pollution in Massachusetts Bay and Buzzards Bay, Massachusetts	1984		1	1983-1984				X					X					X																
Estrella, B.T.	Massachusetts Coastal Commercial Lobster Trap Sampling Program May - November, 1981	1983		1	1981				X					X			X			X		X							X						
Estrella, B.T.	Massachusetts Coastal Commercial Lobster Trap Sampling Program, May-November 1981	1983		1	1981				X					X			X			X		X							X						
Estrella, B.T.	Recent Molting of Lobsters Anomalous in Massachusetts	1981		3	1980				X																										
Estrella, B.T.	Shell Disease in American Lobster (*Homarus americanus*, H. Milne Edwards, 1837) From Massachusetts Coastal Waters with Considerations for Standardizing Sampling	1991		2	1989				X					X					X																
Estrella, B.T.//Glenn, R.P.	Massachusetts Coastal Commercial Lobster Trap Sampling Program May - November, 1998	1999		1	1998				X		X			X			X																		
Estrella, B.T.//Glenn, R.P.	Massachusetts Coastal Commercial Lobster Trap Sampling Program May - November, 1999	2000		1	1999				X					X			X																		
Estrella, B.T.//Glenn, R.P.	Massachusetts Coastal Commercial Lobster Trap Sampling Program May - November, 2000	2001		1	2000				X					X			X																		
Estrella, B.T.//McKiernan, D.J.	Catch-per-unit-effort and Biological Parameters from the Massachusetts Coastal Lobster (Homarus americanus) Resource: Description and Trends	1989		1	1981-1986				X		X			X				X		X															
Estrella, B.T.//Morrissey, T.D.	Seasonal Movement of Offshore American Lobster, *Homarus americanus*, Tagged along the Eastern Shore of Cape Cod, Massachusetts	1997		2 or 3	1969-1971							X						X																	
Estrella, B.T.//O'Gorman, J.B.	Massachusetts Coastal Commercial Lobster Trap Sampling Program, May-November 1982	1983		1	1982				X		X			X			X					X							X						
Estrella, B.T.//O'Gorman, J.B.	Massachusetts Coastal Commercial Lobster Trap Sampling Program, May-November 1983	1985		1	1983				X		X			X			X					X							X						
Estrella, B.T.//O'Gorman, J.B.	Massachusetts Coastal Commercial Lobster Trap Sampling Program, May-November 1984	1986		1	1984				X		X			X			X					X							X						

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria													Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Estrella, B.T//Cadrin, S.X.	Fecundity of the American Lobster (Homarus americanus) in Massachusetts Coastal Waters	1995		3					X									X																
Incze, L.S.//Wahle, R.A.//Cobb, J.S.	Quantitative Relationships Between Postlarval Production and Benthic Recruitment in Lobsters, Homarus americanus	1997		2	1989-1995			X						X																				
James-Pirri, M.J.//Cobb, J.S.	Growth Rates of Planktonic and Newly Settled American Lobsters Homarus americanus	1997		2	1991-1994	X											X											X							
Juinio, M.A.R.	Feeding Ecology of the Postlarval Lobster Homarus americanus. Ph.D Dissertation	1991		2		X																												
Karnofsky, E.B.//Atema, J.//Elgin, R.H.	Natural Dynamics of Population Structure and Habitat Use of the Lobster, Homarus americanus, in a Shallow Cove	1989		3					X									X																
Lawton, R.////	Distribution and Abundance of Larval American Lobsters (H. americanus) in the Western Inshore Region of Cape Cod Bay	1983		3	1974-1977							X		X														X							
Lund, W.A//Stewart, L.L.	Abundance and Distribution of Larval Lobsters, Homarus americanus, off the Coast of Southern New England	1970		2	1966-1969							X		X							X							X							
MacKenzie, C.//Moring, J.R.	Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) - American Lobster	1985		2		X	X	X	X	X	X							X											X						
Matthiessen, G.//Scherer, M.	Observations on the Seasonal Occurrence Abundance and Distribution of Larval American Lobsters (H. americanus) in Cape Cod Bay	1983		3	1974-1976							X																							
Wahle, R.A.	Recruitment to American Lobster Populations along an Estuarine Gradient	1993		2			X						X	X																					
	QUAHOG																																		
Bearse, D.T.	Density and Distribution of the Ocean Quahog (Arctica islandica) in Rhode Island Waters Relative to Various Environmental Factors. M.S. Thesis	1976		2		X						X		X																					
Bricelj, V. M.	Aspects of Biology of the Northern Quahog, Mercenaria mercenaria, with Emphasis on Growth and Survival during Early Life History	1992		2			X								X			X																
Bricelj, V.M.//Malouf, R.E.	Influence of Algal and Suspended Sediment Concentrations on the Feeding Physiology of the Hard Clam Mercenaria mercenaria	1984	Benthic	1	Mar 1983 - Nov 1983							X			X							X					X					X			
Bricelj, V.M.//Malouf, R.E.//de Quillfeld, C.	Growth of Juvenile Mercenaria mercenaria and the Effect of Resuspended Bottom Sediments	1984	Benthic	1								X			X							X					X					X			
Bricelj, V.M.//Rice, M.A.//Grossman-Garber, D., = (Eds.)	Aspects of the Biology of the Northern Quahog, Mercenaria mercenaria, with Emphasis on Growth and Survival during Early Life History	1993		2			X											X																
DeAlteris, J.//Perry, N.//DeBlois, G.//Carvalho, G.//Holst, A //Ganz, A.//Rice, M.A//Willis, J.	Research Priorities for Quahog Management: Transcripts of a Panel Discussion	1993		3																															
Fogarty, M.J.	Assessment of the Ocean Quahog, Arctica islandica, Resource in Rhode Island Sound and South of Martha's Vineyard, MA	1979		2				X				X		X																					
Fogarty, M.J.	Distribution and Relative Abundance of the Ocean Quahog Arctica islandica in Rhode Island Sound and off Martha's Vineyard, Massachusetts	1981	Fisheries	1	1978-1978			X		X				X								X													
Ganz, A.//Valliere, A.//Gibson, M.//Lazar, N.	Narragansett Bay Quahaug Management Plan	1999		2			X										X																	
Ganz, A.R.//Lazar, N.//Valliere, A.	Quahog Management Project, Phase I, Greenwich Bay	1994		2			X						X						X															
Hickey, J.M.	Assessment of Quahog Stocks in Contaminated Waters of Southeastern Massachusetts	1983		1	1980-1981							X							X																
Malinowski, S.M.//Rice, M.A.//Grossman Garber, D., = (Eds.)	Effects of Density on Adult Growth, Survivorship, Fecundity, and Recruitment of Northern Quahogs	1993		2 or 3	1982-1983							X		X					X																
Murawski, S.A.//Ropes, J.W.//Serchuk, F.M.	Growth of the Ocean Quahog, Arctica islandica, in the Middle Atlantic Bight	1982		2											X																				
Pratt, S.D.//Ganz, A.R.//Rice, M.A.	A Species Profile of the Quahog in Rhode Island. Prepared for Rhode Island Sea Grant Program	1992		1	1992			X							X			X											X						

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Rice M.A.//Hickox, C.//Zehra, I.	Effects of Intensive Fishing Effort on the Population Structure of Quahogs, Mercenaria mercenaria, (Linnaeus 1758), in Narragansett Bay	1989	Benthic; Phys. Impacts	2	1989		X												X																		
Rice, M.A.	Overview of Quahog Management Studies in Narragansett Bay, 1946 to 1992	1993		2			X											X		X																		
Rice, M.A.	The 1995 Status of the Shellfisheries for the Northern Quahog, Mercenaria mercenaria (L.) in New England	1996		2																																		
Rice, M.A.	Uptake of Dissolved Free Amino Acids by Northern Quahogs, Mercenaria mercenaria, and its Relative Importance to Organic Nitrogen Deposition in Narragansett Bay, Rhode Island	1999		2	1990		X																														
Rice, M.A.//Valliere, A.//Gibson, M.//Ganz, A.	Ecological Significance of the Providence River Quahogs: Population Filtration	2000		3			X																														
Ropes, J.W.//Murawski, S.A.//Serchuk, F.M.	Size, Age, Sexual Maturity, and Sex Ratio in Ocean Quahogs, Arctica islandica Linné, off Long Island, New York	1984		2	1978									X	X			X																		
Sparsis, M.//Dealteris, J.T.//Rice, M.A.	Effects of Bottom Cultivation on Quahogs and Other Bottom Invertebrates in Narragansett Bay	1993		2	1989-1991		X							X													X									
	SHELLFISH GENERAL																																					
Alber, M.	Shellfish in Buzzards Bay: A Resource Assessment	1988		2	1967-1985				X					X				X																		
Cardwell, R.D. //Woelke, C.E.//Carr, M.I.//Sanborn, E.W.	Sediment and Elutriate Toxicity to Oyster Larvae	1976	Historic Disposal	2																																		
Clancy, M.//Cobb, J. S.	Effect of Wind and Tidal Advection on Distribution Patterns of Rock Crab Cancer irroratus megalopae in Block Island Sound, Rhode Island	1997		1		X	X									X						X						X									
Clancy, M.//Cobb, J.S.	Abundance of Cancer Crab Megalopae and the Potential Ramifications to Population Regulation	1991		2		X								X																						
Duncan, T.K.	Life History and Ecology of Almyracuma proximoculi	1981		3																																		
Ganz, A.R.	Survey of the Oyster Resource in the Vicinity of Sabin Point, East Providence, RI	1991		2			X											X																		
Hampson, G.R.	Ground Truth Verification of a REMOTS Survey of Buzzards Bay	1987		2	1965				X			X						X																		
Kruczynski W.L.	Relationship Between Depth and Occurrence of Pea Crabs Pinnotheres maculates in Blue Mussels Mytilus edulis in the Vicinity of Woods Hole, Massachusetts, USA	1974		3								X		X	X													X								
Leavitt, D.F.//Capuzzo, J.M.//Lancaster, B.A.	What does Condition Index tell Us about Softshell Clam Physiology?	1995		3					X					X																						
Leonard, K. = III//Dougal, J.//Gomez-Chiarri, M.//	Detecting the Presence of Perkinsus marinus and Haplosporidium nelsoni in the Oyster, Crassostrea virginica, in Rhode Island Waters: A Survey Update	2000		3																																		
McKnight, A.//Mathews, L.//Avery, R.//Lee, K.T.	Distribution and Color Morph Ecology of Green Crabs in Southern New England	1997		3																																		
O'Connor, T.P.//Beliaeff, Benoit	Recent Trends in Coastal Environmental Quality: Results from the Mussel Watch Project			2	1986-1993		X	X		X					X			X																		
Rice, M.A.//Goncalo, J.E.	Spatial and Temporal Distribution of Bivalve Larvae in Greenwich Bay, Rhode Island, during the Summer of 1993	1995		2				X							X																						
Rice, M.A.//Grady, M.//Schwartz, M.L. = (Eds.)	Proceedings of the First Rhode Island Shellfisheries Conference	1991		2				X														X												X			
Rice, M.A.//Valliere, A.//Caporelli, A.	A Review of Shellfish Restoration and Management Projects in Rhode Island	2000		2				X									X																				
Robinson, W.E.//Wehling, W.E.//Morse, M.P.	The Effect of Suspended Clay on Feeding and Digestive Efficiency of the Surf Clam, Spisula solidissima (Dillwyn)	1984		3															X																		
Russell-Hunter, W.D.//McMahon, R.F.	An Anomalous Sex-ratio in the Sublittoral Marine Snail, Lacuna vincta Turton, from near Woods Hole	1975	Benthic	3	1968-1973					X					X																						
Turner, W.H.//Tammi,, K.A.//Rice, M.A.	'Bags to Drags,' The Story of the Bay Scallop Restoration Project	1997		3																																		
	TAUTOG																																					
Cooper, R.A.	Age and Growth of the Tautog, Tautoga onitis (Linnaeus), from Rhode Island	1967		3			X								X																						

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria															Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Dorf, B.A.	Ecology of Juvenile Tautog (Tautoga onitis) in Narragansett Bay, Rhode Island. Ph.D. Dissertation	1994		2			X							X																						
Dorf, B.A//Powell, J.C.	Distribution, Abundance, and Habitat Characteristics of Juvenile Tautog (Tautoga onitis, Family Labridae) in Narragansett Bay, Rhode Island, 1988-1992	1997		1	1988-1992		X							X			X																			
Lynch, T.R.	Tautog Studies - Narragansett Bay and Rhode Island Coastal Waters 1987 - 1993 Completion Report	1994		1			X	X									X																			
Sogard, S.M.//Able, K.W.//Fahay, M.P.	Early Life History of the Tautog Tautoga onitis in the Mid-Atlantic Bight	1992		1	1972-1989			X				X						X			X							X								
	FISH GENERAL																																				
Armstrong, M.P.//Musick, J.A.//Colvocoresses, J.A.	Food and Ontogenetic Shifts in Feeding of the Goosefish, Lophius americanus	1996		2 or 3											X																						
Balcom, N.//Leamon, J.//Bomster, W.J.	Royal Red Shrimp: An Emerging Deep-sea Fishery in the Northeast	1996		2	1995													X																		
Beccasio, A.D.//Weissberg, G.H.//Redfield, A.E.//Frew, R.L.//	Atlantic Coast Ecological Inventory User's Guide and Information Base	1980		2		X		X			X																										
Berlinsky, D.L.//Fabrizio, M.C.//O'Brien, J.F.//Specker, J.L.	Age-at-maturity Estimates for Atlantic Coast Female Striped Bass	1995		2										X														X								
Bowman, R.E.//Michaels, W.L.	Food of Seventeen Species of Northwest Atlantic Fish	1984		2	1973-1976									X	X																						
Bowman, R.E.//Stillwell, C.E.//Michaels, W.L.//Grosslein, M.D.	Food of Northwest Atlantic Fishes and Two Common Species of Squid	2000		1	1977-1980													X																		
Connor, M.S.	Snail Grazing Effects on the Composition and Metabolism of Benthic Diatom Communities and Subsequent Effects on Fish Growth. Ph.D. Thesis	1980	Benthic	3					X						X																						
Cunningham, S.//Dunn, M.R.//Whitmarsh, D.	Fisheries Economics: An Introduction	1985		2 or 3																																	
Curley, J.R.//Lawton, R.P.//Chadwick, D.L.//Reback, K.//Hickey, J.M.	A Study of the Marine Resources of the Taunton River and Mount Hope Bay	1974	Water Quality	3																																	
Davis, J.P.//Sisson, R.T.	Aspects of the Biology Relating to the Fisheries Management of New England Populations of the Whelks, Busycotypus canaliculatus and Busycon carica	1988		1							X								X			X							X								
Durbin, A.G.//Durbin, E.G.	Effects of Menhaden Predation on Plankton Populations in Narragansett Bay, Rhode Island	1998		2			X									X																				
Eddie, G.C.	Engineering, Economics and Fisheries Management	1983		2																																	
Frisbie, C.M.	Age and Growth of the Striped Bass, Roccus saxatilis (Walbaum) in Massachusetts Coastal Waters. M.S. Thesis	1967		2	1956-1959										X																						
Fuiman, L.A.	American Fisheries Society Symposium, Vol 14. Water Quality and the Early Life Stages of Fishes	1993		2			X					X																								
Gaines, S.//Bertness, M.D.	Dispersal of Juveniles and Variable Recruitment in Sessile Marine Species	1992	Benthic	3			X							X				X																		
Gibson, M.R.	Comparison of Trends in the Finfish Assemblage of Mt. Hope Bay and Narragansett Bay in Relation to Operations at the New England Power Brayton Point Station. A Report to the Brayton Point Technical Advisory Committee	1995		3	1995		X												X																	
Gleason, T.R.//Bengtson, D.A.	Growth, Survival and Size-selective Predation Mortality of Larval and Juvenile Inland Silversides, Menidia beryllina (Pisces; Atherinidae)	1996		2										X	X																						
Govoni, J.	The Distribution of Some Marine Fish Eggs and Larvae in the Acushnet and Westport River Estuarine Systems, MA. M.S. Thesis	1973		3																																	
Harris, J.S.//DeAlteris, J.T.	Preliminary Analysis of Selectivity of 14.0 cm (5.5 in) and 15.2 cm (6.0 in) Square and Diamond Mesh Cod-ends for Yellowtail Flounder in New England Commercial Bottom Trawls	1992		2	1992							X		X					X																		
Hennessey, T.//Healey, M.	Ludwig's Ratchet and the Collapse of New England Groundfish Stocks	2000	Physical Impacts	2	1977-1997							New England							X																		
Howe,A.B.//Currier, T.P.//King, J.R.//Johnston, R.	United States Fish and Wildlife Service Federal Aid to Sport Fish Restoration Act Annual Report	2002		1	2001									X																						

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																	Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Huber, M.	Aspects of Reproductive Ecology of Menidia Menidia (L.) and Menidia Beryllina (Cope) in Southern Rhode Island	1990		3			X																														
Huber, M.	Environmental Control of Reproduction in an Estuarine Fish, *Menidia beryllina* (Cope), in Rhode Island	1995		3											X																						
Intergovernmental Policy Analysis Program, University of Rhode Island	The Commercial Fishing Industry in Rhode Island: An Inventory, Analysis and Assessment Prepared for the Rhode Island Port Authority and Economic Development Corporation	1989		2	1980-1989													X																			
Jeffries, H.P.	The Impacts of Warming Climate on Fish Populations	1994		2			X	X									X		X																		
Jeffries, H.P.//Terceiro, M.	Cycle of Changing Abundances in the Fishes of the Narragansett Bay Area	1985		2	1968-1982		X							X			X			X																	
Johnson, L.L.//Stehr, C.M.//Olson, O. P.//Myers, M.S.//Pierce, S.M.//McCain, B.B.//Varanasi, U.	Fish Histopathology and Relationships Between Lesions and Chemical Contaminants (1987-89)	1992	Sediment	2	1987-1989		X		X																												
Keefe, M.//Winn, H.E.	Chemosensory Attraction to Home Stream Water and Conspecifics by Native Brook Trout, Salvelinus fontinalis, from Two Southern New England Streams	1991		3																																	
Kendall, A.W. =, Jr.//Walford, L.A.	Sources and Distribution of Bluefish, Pomatomus saltatrix, Larvae and Juveniles off the East Coast of the United States	1979		2																																	
Klein-MacPhee, G.//Sullivan, B.K.//Keller, A.A.	Using Mesocosms to Assess the Influence of Food Resources and Toxic Materials on Larval Fish Growth and Survival	1993	Water Quality	3									X		X																						
Langton, R.//North, B.M.//Hayden, B.P.//Bowman, R.E.	Fish, Food-Habit Studies - Sampling Procedures and Data Processing Methods Utilized by the Northeast Fisheries Center, Woods Hole Laboratory, USA	1980		3	1963-1980							X		X	X			X																			
Lapolla, A.E.	Bay Anchovy Anchoa mitchilli in Narragansett Bay, Rhode Island. I. Population Structure, Growth and Mortality	2001		2			X							X				X																			
Lapolla, A.E.	Bay Anchovy Anchoa mitchilli in Narragansett Bay, Rhode Island. II. Spawning Season, Hatch-date Distribution and Young-of-the-year Growth	2001		2			X							X				X																			
Lawton, R.	A Literature Review of the Bluefish Pomatomus saltatrix (L), with Emphasis on Populations in Buzzards Bay, MA. M.S. Thesis	1974		3	1972				X					X																							
Letcher, B.H.//Bengtson, D.A.	Effects of Food Density and Temperature on Feeding and Growth of Young Inland Silversides (Menidia beryllina)	1993		3																																	
Lund, W.A.//Maltezos, G.S.	Movements and Migrations of Tagged Bluefish off New York and Southern New England	1970		3																																	
Lux, F.E.//Nichy, F.E.	Numbers and Lengths, by Season, of Fishes Caught with an Otter Trawl Near Woods Hole, Massachusetts, September 1961 to December 1962	1971		1	9/61-12/62							X	X	X	X		X					X										X					
Lynch, T.R.	Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters. Coastal Fishery Resource Assessment Trawl Survey. Segment No. 8	2000		1			X										X																			
Margraf, F.J//Riley, L.M.	Evaluation of Scale Shape for Identifying Spawning Stocks of Coastal Atlantic Striped Bass (Morone saxatilis)	1993		3										X				X																			
Martin, M.H.	The Effects of Temperature, River Flow, and Tidal Cycles on the Onset of Glass Eel and Elver Migration into Fresh Water in the American Eel	1995		1	1990			X							X																			X			
Mather, F.J. = III	Distributional Records of Fishes from Waters off New England and the Middle Atlantic States	1957		3						X											X																
Mather, F.J. = III	Northerly Occurrences of Warm Water Fishes in the Western Atlantic	1954		3						X											X																
McBride, R.S.//Scherer, M.D.//Powell, J.C.	Correlated Variations in Abundance, Size, Growth, and Loss Rates of Age-0 Bluefish in a Southern New England Estuary	1995		1	1982-1992			X							X																			X			
Meng, L.//Powell, J.C.	Linking Juvenile Fish and their Habitats: An Example from Narragansett Bay, Rhode Island	1999		2	1988-1996			X					X	X						X		X											X			
Moring, J.R.//Van Den Ende, O.//Hockett, K.S.	Predation on Atlantic Salmon Smolts in New England Rivers	1999		3								X						X																		
Moss, S.A.//O'Brien, F.X.//Hoff, J.G.	Forecasting Fish Entrapment by Velocity Cap Intakes: A Comparative Approach	1981		3															X																	
Murawski, S.A.	Factors Influencing By-catch and Discard Rates: Analyses from Multispecies/Multifishery Sea Sampling	1993		3	1989-1992	X	X	X	X	X	X	X							X																	

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria															Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Murawski, W.S.	A Study of Submerged Dredge Holes in New Jersey Estuaries with Respect for their Fitness as Finfish Habitat	1969		3																																	
National Marine Fisheries Service	Guide to Essential Fish Habitat Designations in the Northeastern United States	2002		1		X	X	X	X	X	X	X						X				X						X									
National Marine Fisheries Service	Winter Groundfish Survey Fishermen's Report. Bottom Trawl Survey. Cape Hatteras - SE Georges Bank	2001		1	2001	X		X						X								X						X									
Oliveira, K.	Life History Characteristics and Strategies of the American Eel, Anguilla rostrata	1999		3	1990		X							X																							
Oliveira, K.	Movements and Growth Rates of Yellow-phase American Eels in the Annaquatucket River, Rhode Island	1997		3										X																							
Orciari, R.D.//Leonard, G.H.	Length Characteristics of Smolts and Timing of Downstream Migration among Three Strains of Atlantic Salmon in a Southern New England Stream	1996		3										X																							
Orciari, R.D.//Leonard, G.H.//Mysling, D.J.	Survival, Growth, and Smolt Production of Atlantic Salmon Stocked as Fry in a Southern New England Stream	1994		3																																	
Overholtz, W.J.//Armstrong, R.S.//Mountain, D.G.//Tercerio, M.	Factors Influencing Spring Distribution, Availability, and Recreational Catch of Atlantic Mackerel (Scomber scombrus) in the Middle Atlantic and Southern New England Regions	1991		3	1971-1987							VA-ME						X				X																
Powell, J.C.	Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters. Narragansett Bay Juvenile Finfish Survey Segment No. 7	2000		1	1999		X										X																				
Powell, J.C.	Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters. Narragansett Bay Juvenile Finfish Survey Segment No. 8	2000		1	2000		X										X																				
Powell, J.C.	Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters. Narragansett Bay Juvenile Finfish Survey Segment No. 9	2001		1	2001		X										X																				
Reback, K.E.//DiCarlo, J.S.	Final Completion Report Anadromous Fish Project	1970		3																																	
Rinkel, L.A.//Valliere, A.K	Identification of Fishery Resources by Literature Search in the Proposed Dredge Disposal Sites in Narragansett Bay	1995		2	1971-1995		X											X				X						X									
Seawifs-gsfc	Ocean Planet: Perils - Overfishing Commercially Important Fish	1992		3																																	
Shepherd, G.R.//Terceiro, M.	The Summer Flounder, Scup, and Black Sea Bass Fishery of the Middle Atlantic Bight and Southern New England Waters	1994		1	1979-1990														X	X								X									
Sissenwine, M.P.//Saila, S.B.	Rhode Island Sound Dredge Spoil Disposal and Trends in the Floating Trap Fishery	1975		2	1967-1970			X											X			X	X											X			
Smith, J.W.	Distribution of Atlantic Menhaden, Brevoortia tyrannus, Purse-seine Sets and Catches from Southern New England to North Carolina, 1985-96	1999		2				X																													
Wigley, S.E.//Serchuk, F.M.	Spatial and Temporal Distribution of Juvenile Atlantic Cod Gadus morhua in the Georges Bank-Southern New England Region	1992		1	1982-1986						X	shoals		X								X												X			
Wigley, S.E//Gabriel, W.L.	Distribution of Sexually Immature Components of to Northwest Atlantic Groundfish Species based on Northeast Fisheries Center Bottom Trawl Surveys, 1968-86	1991		2	1968-1986			X				X						X				X															
	New England Cod Success	1997		3																																	
	OTHER FISH																																				
(Ed) Castro//Corey//DeAlteris//Gagnon	Proceedings of the East Coast By-Catch Conference	1996		3																																	
Brady-Campbell, M.M.	An Assessment of the Productivity of Two Species of Laminaria (Phaeophyta, Laminariales) in Narragansett Bay and Rhode Island Sound	1982		2			X	X																													
Burns, B.R.	Distribution and Biology of Mysids (Crustacea, Mysidacea) from the Atlantic Coast of the United States in NMFS Woods Hole Collection	1971		1	1953-1969															X																	
Butman, C.A.	Sediment-trap Experiments on the Importance of Hydrodynamical Processes in Distributing Settling Invertebrate Larvae in Near-bottom Waters	1990	Benthic	2	1980-1982				X					X																								
Caporale, D.A.//Beal, B.F.//Roxby, R.//Van Beneden, RJ.	Population Structure of Mya arenaria along the New England Coastline	1997		3								X			X																						

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria												Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Connor, M.S.//Teal, J.M.//Valiela, I.	The Effect of Grazing by Mud Snails (Ilyanassa obsolets) on the Structure and Metabolism of a Benthic Algal Community	1982	Benthic	3											X																			
Corey, S.	Reproductive Strategies and Comparative Fecundity of Crangon septemspinosa Say (Decapoda, Caridea)	1987		3			X	X	X	X	X	X		X															X					
Durbin, A.G.//Durbin, E.G.	Zooplankton and Ichthyoplankton in Narragansett Bay: Status and Trends Part 2: Ichthyoplankton	1990	Water Quality	1			X							X																				
Feigenbaum, D.	Feeding by the Chaetognath sagitta elegans at Low Temperature in Vineyard Sound, Massachusetts, USA	1982		3						X				X	X																		
Fell, P.E.//Warren, R.S.//Niering, W.A.	Restoration of Salt and Brackish Tidelands in Southern New England: Angiosperms, Macroinvertebrates, Fish, and Birds	2000	Sediment; Public Parklands	3			X						X						X															
Giuliano, D.F.	Biological Considerations in the BIFI Range	1969	Benthic	2		X								X																				
Gleason, T.R.	The Relationship Between Size and Survival for the Early Life History Stages of Menidia beryllina (Cope) in a Rhode Island Estuary (Predation, Size Classes). Ph.D. Dissertation	1995		2	1990-1992									X	X							X							X			X		
Hampson, G.R.	A Species Pair of the Genus Nucula (Bivalvia) from the Eastern Coast of the United States	1971		2	1965							SE Mass						X											X					Note: Info on 2 closely related bivalve species in SE Mass
Hampson, G.R.	Redescription of a Commensal Pelecypod, Rochefortia cuneata with Notes on Ecology	1964		3					X									X																
Hannesson, R.	Economics of Fisheries: An Introduction	1978		2												X																		
Hargraves, P.E.	Phytoplankton of Narragansett Bay	1988	Water Quality	2			X											X																
Herman, S.S.	Planktonic Fish Eggs and Larvae of Narragansett Bay	1963		1	Mar 1957-Mar. 1958		X							X								X	X						X					
Keller, A.A.//Klein-MacPhee, G.//St. Onge-Burns, J.	Changes in Abundance and Distribution of Ichthyoplankton in Narragansett Bay, Rhode Island, 1989-1990	1999		1	1972-1990		X							X				X				X							X			X		
Lamoureux, J.E.	Analysis of the Zooplankton of Block Island Sound	1967	Water Quality	3	7/22-7/26 1967	X																												
Lawson, R.M.	Economics of Fisheries Development	1984		2																														
Macy, W.K. = III//Brodziak, J.K.T.	Seasonal Maturity and Size at Age of Loligo pealeii in Waters of Southern New England	2001		2	1993-1997		X		X				X	X	X																			
Mann, R.	Larval Ecology of Arctica islandica on the Inner Continental Shelf of the Eastern United States	1990		3																														
National Marine Fisheries Service	Fall Groundfish Survey Fishermen's Report. Bottom Trawl Survey. Cape Hatteras - Gulf of Maine	2001		1	2001		X		X					X								X							X					
National Marine Fisheries Service	Fisherman's Report. Sea Scallop Survey	2001		3	2001									X																				
National Marine Fisheries Service	Fishermen's report, fall bottom trawl survey, preliminary catch summary, Cape Hatteras - Gulf of Maine, September 9 - October 30, 1997	1997		1	1997		X	X	X	X	X	X	X		X								X							X			X		
National Marine Fisheries Service	Letter Correspondence from Mike Ludwig, NMFS to Richard Reardon, U.S. Army Corps of Engineers, February 13, 1998	1998	Endangered Species	1	1998		X	X	X										X											X					
National Marine Fisheries Service	Spring Groundfish Survey Fishermen's Report. Bottom Trawl Survey. Cape Hatteras - Gulf of Maine	2001		1	2001				X		X			X								X							X					
Pennington, M.//Godo, O.R.	Measuring the Effect of Changes in Catchability on the Variance of Marine Survey Abundance Indices	1995		3																														
Quinn, E.//Paradise, K.//Atema, J.	Juvenile Limulus polyphemus Generate Two Water Currents that Contact One Proven and One Putative Chemoreceptor Organ	1998		3																														
Rosenberg, A.A.//Brault, S.	Choosing a Management Strategy for Stock Rebuilding when Control is Uncertain	1993		2												X																		
Smith, R.	Management of Marine Fisheries through the Rhode Island Marine Fisheries Council	1993		3					X																									
Steimle, F.W.//Zetlin, C.	Reef Habitats in the Middle Atlantic Bight: Abundance, Distribution, Associated Biological Communities, and Fishery Resource Use	2000	Sediment	1			X		X	X	X	X			X								X							X					

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria													Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Stevens, J.//Pilaro, M.//Geagan, D.	The Greenwich Bay Initiative: A Case Study of Shellfish Habitat Restoration through Land Use Planning	1997		3	1992		X																											
Tammi, K.A.//Soares, S.J.//Turner, W.H.//Rice, M.	Settlement and Recruitment of Bay Scallops, Argopecten irradians, to Artificial Spat Collectors in the Westport River Estuary, Westport, Massachusetts	1994		3	1993																													
Theroux, R.B.//Wigley, R.L.	Distribution and Abundance of East Coast Bivalve Mollusks based on Specimens in the National Marine Fisheries Service Woods Hole Collection		Benthic	3	1903-1971													X		X									X						
Whitehouse, S.T.	The Abundance and Distribution of Crangon septemspinosa in Narragansett Bay and the Importance of C. septemspinosa as a Predator of Benthic Macrofauna and Newly Metamorphosed Pleuronectes americanus (Rhode Island). Ph.D. Dissertation	1994	Benthic	2			X								X																				
Williams, A.B.//Wigley, R.L.	Distribution of Decapod Crustacea off Northeastern United States Based on Specimens at the Northeast Fisheries Center, Woods Hole, Massachusetts	1977	Benthic	2	~1950-1976							X						X														X			
F. Benthic (Macro-Invertebrate) Resources Data and Investigations																																			
Auster, P.J.//Malatesta, R.//LaRosa, S.C.	Patterns of Microhabitat Utilization by Mobile Megafauna on the Southern New England (USA) Continental Shelf and Slope	1995		1		X																													
Banta, G.T.//Giblin, A.E.//Hobbie, J.E.//Tucker, J.	Benthic Respiration and Nitrogen Release in Buzzards Bay, Massachusetts	1995	Phys. O; Water Quality; Sediments; Fisheries; Archaeology.	3	Aug. 1989				X					X																					
Bertness, M.D.//Gaines, S.D.//Bermudez, D.//Sanford, E.	Extreme Spatial Variation in the Growth and Reproductive Output of the Acorn Barnacle Semibalanus balanoides	1991		3			X																												
Bertness, M.D.//Gaines, S.D.//Wahle, R.A.	Wind-driven Settlement Patterns in the Acorn Barnacle Semibalanus balanoides	1996	Fisheries	2			X							X																					
Bertness, M.D.//Leonard,G.H.//Levine, J.M.	Testing the Relative Contribution of Positive and Negative Interactions in Rocky Intertidal Communities	1999		3																															
Bilyard, G.R.	The Value of Benthic Fauna in Marine Pollution Monitoring Studies	1987	Fishing Activities Human Health Risk	3																															
Bothner, M.H.//Spiker, E.C.//Johnson, P.P.//Rendigs, R.R.//Aruscavage, P.J.	Geochemical evidence for modern sediment accumulation on the continental shelf off southern New England	1981	Sediment	2							X			X																					
Brown, A.F.	Molecular Ecology and Biogeography of the Acorn Barnacle Semibalanus balanoides (Phylogenetics). Ph.D. Dissertation	1995		3											X																				
Bugley, K.E//Carr, A.H.	Massachusetts Coastal Waters: The Status and Potential for Artificial Reefs	1994		2	1978-1981						X											X								X				
Bumpus, D.F.//Wright, W.R.//Vaccaro, R.F.	Sewage disposal in Falmouth, Massachusetts	1971	Phys. O; Water Quality	3						X	X																								
Conover, J.T.	Seasonal Growth of Benthic Marine Plants as Related to Environmental Factors in an Estuary	1958		3	1952-1954							X		X			X		X																
Costa, J.E.	Eelgrass in Buzzards Bay: Distribution, Production and Historical Changes in Abundance	1988	Sediment	1					X								X																		
Crowley, D.J.	The Benthic Fauna and Sediment Relationships of Eastern Narragansett Bay, Rhode Island	1962	Sediment; Phys. O	2			X							X																					
Dorsey, E.M.//Pederson, J.	Geological overview of the sea floor of New England	1998	Phys Impact	2							X	X							X																
Driscoll E.G.//Brandon, D.E.	Mollusk Sediment Relationships in Northwestern Buzzards Bay, Massachusetts, USA	1973	Sediment	1					X				X																						
Driscoll, E.G.	Sublittoral Attached Epifaunal Development in Buzzards Bay, Massachusetts Bay, Massachusetts, USA	1968		3	1965-1966				X					X																					
Driscoll, E.G.//Swanson, R.A.	Diversity and Structure of Epifaunal Communities on Mollusc Valves, Buzzards Bay, Massachusetts	1973		3					X					X																					

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																	Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Emery, K.O.//Uchupi, E.	Western North Atlantic Ocean: Topography, Rocks, Structure, Water, Life, and Sediments	1972	Phys O; Sediment; Water Quality	2							X							X																				
Gordon, R.B.//Spaulding, M.L.	A nested numerical tidal model of the Southern New England Bight	1979		1							X																											
Grassle, J. F.//Grassle, J.P.//Brown-Leger, L.S.//Petrecca, R.F.//Copley, N.J.	Subtidal Macrobenthos of Narragansett Bay. Field and Mesocosm Studies of the Effects of Eutrophication and Organic Input on Benthic Populations	1985		2			X						X																									
Hannan, C.A.	Initial Settlement of Marine Invertebrate Larvae: The Role of Passive Sinking in a Near-bottom Turbulent Flow Environment. Ph, D. Thesis	1984		2										X	X																							
Holohan, B.A.//Klos, E.G.//Oviatt, C.A.	Population Density, Prey Selection, and Predator Avoidance of the Burrowing Anemone (Ceriantheopsis americanus) in Narragansett Bay, Rhode Island	1998		2			X				X							X																				
Kelz, R.C.	Benthic Respiration and Production in the Pettaquamscutt River Estuary and Narragansett Bay	1992		2			X							X	X																							
Levin, L.A.//Etter, R.J.//Rex, M.A.	Environmental Influences on Regional Deep-sea Species Diversity	2001		3																																		
Limeburner, R.//Beardsley, R.C.//Esaias, W.	Biological and Hydrographic Station Data Obtained in the Vicinity of Nantucket Shoals, May 1978 – May 1979.	1980		2							X																											
Maguire Group, Inc	November 2000 REMOTS Survey at Two Candidate Dredged Material Disposal Sites in Buzzards Bay	2001	Historic Dredging; Sediment	1	2000				X									X																				
Maguire Group, Inc.	November 2000 Baseline Characterization of Benthic Macroinvertebrate Communities at Two Candidate Dredged Material Disposal Sites in Buzzards Bay	2001	Historic Dredging	1	2000				X									X																				
McElroy, A.E.//Farrington, J.W.//Teal, J.M.	Influence of Mode of Exposure and the Presence of a Tubiculous Polychaete on the Fate of Benz(a)anthracene ((BaA)) in the Benthos	1990		3											X																							
Michael, A.D.	Structure and Stability in Three Marine Benthic Communities in Southern New England	1975		3																																		
Monaco, M.E.//Ulanowicz, R.E.	Comparative Ecosystem Trophic Structure of Three U.S. Mid-Atlantic Estuaries	1997	Water Quality	3			X																															
Moskovits, G.	Preliminary Studies on Some Aspects of Bacteria-plankton Relations in Vineyard Sound	1951	Water Quality	3						X				X						X																		
Nichols, J.A.//Rowe, G.T.//Clifford, C.H.//Young, R.A.	In-situ Experiments on the Burial of Marine Invertebrates	1978		2					X						X																			X				
Onbé, T.	Some Aspects of the Biology of Resting Eggs of Marine Cladocerans	1991		3					X																													
Palma, A.T.//Steneck, R.S.//Wilson, C.J.	Settlement-driven, Multiscale Demographic Patterns of Large Benthic Decapods in the Gulf of Maine	1999	Fisheries	2	1994-1997							X																		X								
Parker, R.H.//Nagle, J.S.//Williams, A.B.//Kaufman, R.	Seasonal Aspects of Hadley Harbor Benthic Ecology	1965		3																																		
Poppe, L.J.//Commeau, J.A.//Valentine, P.C.	Mineralogy of the silt fraction in surficial sediments from the outer continental shelf off southeastern New England	1991	Sediment	2					X		X				X				X																			
Porter, E.T.//Newell, R.I.E.//Sanford, L.P.	Physical and Biological Scaling of Benthic-pelagic Coupling in Coastal Ecosystems: The Role of Bivalve Suspension Feeders	1996	Fisheries	2											X																							
Pratt, S.D.	Benthic fauna	1973		2							X							X																				
Rhoads, D.C.//Germano, J.D.	Characterization of Organism-sediment Relations using Sediment Profile Imaging: An Efficient Method of Remote Ecological Monitoring of the Seafloor (REMOTS System)	1982		2			X							X		X																					
Rhoads, D.C.//Germano, J.D.	Interpreting Long-term Changes in Benthic Community Structure: A New Protocol	1986		3																																		
Rosenberg, R.//Hellman, B.//Johansson, B.	Hypoxic Tolerance of Marine Benthic Fauna	1991		2 or 3											X																							
Sanders, H.L.	Benthic Studies in Buzzards Bay: Animal-Sediment Relationships	1969		3					X																													
Santos, S.L.//Simon, J.L.	Marine Soft-bottom Community Establishment Following Annual Defaunation: Larval or Adult Recruitment	1980		2																																?		

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																	Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Sarda, R.	Macroinfaunal Populations of Polychaetes on a Salt Marsh in Southern New England	1991		2 or 3	1986-1987				X			marsh		X	X																						
Scheltema, R.S.	Development and Planktonic Larvae of Common Benthic Invertebrates of the Woods Hole, Massachusetts Region: Summary of Existing Data and Bibliographic Sources	1984		3																																		
Sears, J.R.//Wilce, R.T.	Sublittoral Benthic Marine Algae of Southern Cape Cod and Adjacent Islands: Seasonal Periodicity, Associations, Diversity, and Floristic Composition	1975		2				X	X	X				X																								
Shimeta, J.//Sisson, J.D.	Taxon-specific Tidal Resuspension of Protists into the Subtidal Benthic Boundary Layer of a Coastal Embayment	1999	Sediment	1	1996				X					X																				X					
Shimeta, J.//Starczak, V.R.//Ashiru, O.M.	Influences of Benthic Boundary-layer Flow on Feeding Rates of Ciliates and Flagellates at the Sediment-Water Interface	2001	Sediment	3					X					X	X																								
Smith, F.E.	The Benthos of Block Island Sound: I. The Invertebrates, their Quantities and their Relations to the Fishes [Microfilm]	1950	Fisheries	3	1950	X								X						X																			
Smith, J.D.	Geomorphology of a sand ridge	1969		2																																			
Sullivan B.K.//Doering, P.H.//Oviatt, C.A.//Keller, A.A.//Frithsen, J.B.	Interactions with the Benthos Alter Pelagic Food Web Structure in Coastal Waters	1991		2	1979-1990		X								X																								
Swanson, R.A.	Structure, Diversity, and Homogeneity of Benthic Epifaunal Communities, Buzzards Bay	1971		3					X				X	X																									
Theroux, R.B.//Wigley, R.L.	Quantitative composition and distribution of the macrobenthic invertebrate fauna of the continental shelf ecosystems of the northeastern United States	1998	Sediment	1		X	X	X		X	X		X																										
U.S. Dept Commerce/NOAA/NMFS/NWFSC/Publications	National Benthic Surveillance Project: Northeast Coast. TM-4: Appendix	2002	Fisheries	2			X		X			X						X																					
Valente, R.M.//Rhoads, D.C. //Germano, J.D.//Cabelli, V.J.	Mapping of Benthic Enrichment Patterns in Narragansett Bay, Rhode Island	1992	Sediment	1	1988		X							X																									
Venkatesan, M.I.//Steinberg, S.//Kaplan, I.R.	Organic geochemical characterization of sediments from the continental shelf south of New England as an indicator of shelf edge exchange	1988	Sediment	2							X			X																									
Weiss, H.M.	Marine Animals of Southern New England and New York: Identification Keys to Common Nearshore and Shallow Water Macrofauna	1995	End. Species	1		X		X	X		X											X											X					
Whitlatch, R.B.	The Ecology of New England Tidal Flats: A Community Profile	1982	Fisheries	2								NE						X																					
G. Physical Impacts of Fishing Activities																																							
Allen, D.W.////	Effects on Commercial Fishing of Petroleum Development off the Northeastern United States: A Study Conducted within the Marine Policy and Ocean Management Program of the Woods Hole Oceanographic Institution	1976		3																																			
Cadrin, S.X.//Howe, A.B.//Correia, S.J.//Currier, T.P.	Evaluating the Effects of Two Coastal Mobile Gear Fishing Closures on Finfish Abundance off Cape Cod	1995	Fisheries	2			X		X	X								X																					
Carr, H.A.//Blott, A.J.//Caruso, P.G.	A Study of Ghost Gillnets in the Inshore Waters of Southern New England	1992	Fisheries	2	1989-1990				X										X																				
DeAlteris, J.//Skrobe, L.//Lipsky, C.	The Significance of Seabed Disturbance by Mobile Fishing Gear Relative to Natural Processes: A Case Study in Narragansett Bay, Rhode Island	1999		1	8/31/95-7/31/98		X	X					X			X			X			X					X					X			X					
Moore, G.//Jennings, S. = (Eds.)	Commercial Fishing the Wider Ecological Impacts	2000		3															X																				
Pollnac, R.B.	Continuity and Change in Marine Fishing Communities	1976		3																																			
H. Fishing Activities and Human Health Risks																																							
I. Information on Marine Wildlife and Endangered Species																																							
Bleakney, J.	Reports of marine turtles from New England and eastern Canada	1965		1							X																							X					
Carr, A.	New perspectives on the pelagic stage of sea turtle development	1986		2							X						X																	X					
Carr, A.	Rips, FADS, and little loggerheads	1986		2							X							X																	X					
Carr, A.	So Excellent a Fishe. A Natural History of Sea Turtles	1967		2							X									X															X					
Dickerson, D.D.//Nelson, D.A.//Wolff, M.//Manners, L.	Summary of dredging impacts on sea turtles, Kings Bay, Georgia and Cape Canaveral, Florida	1992		2								X																						X					

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria											Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Katona, S.K.//Rough, V.R.//Richardson, D.	A Field Guide to the Whales and Seals from Cape Cod to Newfoundland	1993		2							X																X						
Katona, S.K.//Whitehead, H.P.	Are cetacea ecologically important?	1988		2							X																X						
Kenney, R.D.//Scott, G.P.//Thompson, T.J.//Winn, H.E.	Estimates of Prey Consumption and Trophic Impacts of Cetaceans in the USA Northeast Continental Shelf Ecosystem	1997		3		X	X	X	X	X	X	X															X						
Kenney, R.D.//Winn, H.E.	Cetacean High-Use Habitats of the Northeast United States Continental Shelf	1986		1	1978-1982							North east US															X						
Kraus, S.D.//Kenney, R.D.	Information on Right Whales (Eubalaena glacialis) in Three Proposed critical Habitats in U.S. Waters of the Western North Atlantic Ocean	1991		3								X						X									X						
Lazell, Jr., J.D.	New England Waters: Critical Habitat for Marine Turtles	1980		2				X			X																X						
Morreale, S.J.//Standora, E.A.	Habitat use and feeding activity of juvenile Kemp's ridleys in inshore waters of the northeastern U.S.	1992		2							X																X						
National Marine Fisheries Service	Northeast Research and Management Plan for the Ridley Sea Turtle	1988		2		X	X	X	X	X	X																X						
Paton, D.	Gray Seal Pups Establish Critical Marine Habitat in Nantucket Sound, U.S.A.	1988		2	1987-1988					X	X							X									X						
Payne, P.M.//Wiley, D.N.//Young, S.B.//Pittman, S.//Clapham, P.J.//Jossi, J.W.	Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey	1990		2							X							X									X						
Prescott, R.L.	Leatherbacks in Cape Cod Bay, Massachusetts, 1977-1987	1988		2					X	X	X							X									X						
Reeves, R.//Breiwick, J.M.//Mitchell, E.D.	Pre-exploitation abundance of right whales off the eastern United States	1992		2							X								X	X							X						
Reeves, R.R.//Breiwick, J.M.//Mitchell, E.	History of Whaling and Estimated Kill of Right Whales, Balaena glacialis, in the Northeastern United States, 1620-1924	1999		3	1620-1924															X							X						
Reeves, R.R.//Mead, J.G.//Katona, S.	The right whale, Eubalaena glacialis, in the western North Atlantic	1978		2							X							X									X						
Rough, V.	Gray Seals in Nantucket Sound, Massachusetts, Winter and Spring, 1994	1995		2						X	X																X						
Sadove, S.S.//Morreale, S.J.	Marine mammal and sea turtle encounters with marine debris in the New York Bight and the northeast Atlantic	1990		2		X		X		X	X																X						
Schevill, W.E.//Moore, K.E.//Watkins, W.A.	Right Whale, Eubalaena Glacialis, Sightings in Cape Cod Waters	1981		2							X																X						
Schevill, W.E.//Watkins, W.A.//Moore, K.E.	Status of *Eubalaena glacialis* off Cape Cod	1986		2							X					X											X						
Sorenson, P.W.//Medved, R.J.//Hyman, M.A.M.//Winn, H.E.	Distribution and abundance of cetaceans in the vicinity of human activities along the continental shelf of the northwestern Atlantic	1984		2							X							X									X						
Teas, W.G.	Marine turtle stranding trends, 1986 to 1993	1994		2		X	X	X	X	X	X					X											X						
U.S. Fish and Wildlife Service	Endangered Species for RI and MA Region 5 Listings by State and Territory (as of 4/2/2002)	2002		2								RI & MA															X						
U.S. Fish and Wildlife Service	U.S. Listed Invertebrate Animal Species Report by Taxonomic Group	2002		2																							X						
Wiley, D.N.//Asmutis, R.A.//Pitchford, T.D.//Gannon, D.P.	Stranding and Mortality of Humpback Whales, *Megaptera novaeangliae*, in the Mid Atlantic and Southeast United States, 1985-1992	1995		2	1985-1992							Coast-NJ to Florida																						
Winn, H.E.	A Characterization of Marine Mammals and Turtles in the Mid- and North Atlantic Areas of the U.S. Outer Continental Shelf	1982		2			X		X		X	X						X									X						
Winn, H.E.//Goodyear, J.D.//Kenney, R.D.//Petricig, R.O.	Dive patterns of tagged right whales in the Great South Channel	1995		2							X							X									X						
Wishner, K.F.//Durbin, E.//Durbin, A.//Macaulay, M.//Winn, H.//Kenney, R.	Copepod patches and right whales in the Great South Channel off New England	1988		2							X				X												X						
Witherington, B.	Some "lost-year" turtles found	1994		2							X							X									X						
J. Public Parklands, Beaches and Sanctuaries																																		
Massachusetts DEM	DEM Forests and Parks	2002		2					X														X										

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																		Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
Pogue, P.//Lee, V.	Public Access to the Rhode Island Coast : A Selective Guide to Parks, Wildlife Refuges, Beaches, Fishing Sites, Boat Ramps, Pathways, and Views along Rhode Island's Coast	1993		2																									X										
Rhode Island Department of Administration	The Rhode Island Coastal Resources Management Program (CRMP): A Working Paper for Land Use: 2010	1986		2																																			
Rhode Island Parks and Recreation	Listing of State Parks and Beaches	2002		2																		X																	
Zinn, J.A.	The Orientation of Marine Recreation of Communities on Upper Buzzards Bay...	1970		2 or 3																																			
K. Historic, Cultural and Archaeological Resources																																							
Gardner, A.H.	Wrecks Around Nantucket	1943		2			X				X																												
Gibson, S.G.//Cole, S.//Thorbahn, P.//Wood, C.//Stachiw, M.	Archeological Resource Study, Roger Williams National Memorial: Rhode Island. Prepared by Public Archaeology Laboratory, Department of Anthropology, Brown University	1979		3																																			
Holmes, R.D.//Hertz, C.D.//Mulholland, M.T.	Historic Cultural Land Use Study of Lower Cape Cod.	1998		2						X	X									X																			
MCZM	Massachusetts Coastal Zone Management Massachusetts Board of Underwater Archaeological Resources Exempt Shipwreck List Web pages located at http://www.state.ma.us/czm/buares.htm.	2001		1					X	X	X	X																												
MWDC	Metrowest Dive Club New England Shipwreck Diving Information Web pages located at http://www.mwdc.org.	2001		1					X	X	X	X																												
NOAA	Automated Wrecks and Obstructions Information System (AWOIS) http://anchor.ncd.noaa.gov/awois/search.cfm	2002		1		X		X	X		X																												
Riess, W.	Database on Shipwrecks collected by Dr. Warren Riess, Research Associate and Processor of History and Marine Sciences of the University of Maine's Darling Marine Center.	2001		1		X	X	X	X	X	X	X								X																			
L. State Dredged Material Disposal Guidance																																							
Massachusetts Department of Enviromental Protection	Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Water of the United States within the Commonwealth	2002		1					X	X	X	X																												
Moor, S.R.	Inventory of Local Regulations Pertaining to Water Quality in Buzzards Bay	1987		1					X																														
Tippie, V.K.	Dredging and the Disposal of Dredged Materials in Rhode Island	1977		2				X																															Note: RI Bene. Uses of Dredged Mat.; Dredging Alt. Disp. Methods
Unclassified																																							
Ackerman, D.G.////	Destruction and Disposal of PCBs by Thermal and Non-thermal Methods	1983		3																																			
Blanchard, F.S.	Block Island to Nantucket: Narragansett and Buzzards Bays; Block Island, Vineyard and Nantucket Sounds	1961		3			X	X	X	X	X	X																												
Calder, D.R.	Hydroids (Cnidaria: Hydrozoa) Recorded from Depths Exceeding 3000 m in the Abyssal Western North Atlantic	1996		3																																			
Dunkin, T.K.	Life History and Ecology of Almy proximoculi (Crustacean Cumacea). Ph. D. Thesis	1980		3																																			
Earthlink	Energy/Communications Cable Links Nantucket to Mainland	1997		2							X																												
Farrington, J.W.	Coastal Research Center Report of the Period May 1984 - February 1986.Technical Report	1986		3																																			
Huff, L.C.	CW Phase Measurements across Block Island Sound	1969		3		X																																	
Hughes, J.E.	Size-dependent, Small-scale Dispersion of the Capitellid Polychaete, Mediomastus ambiseta	1996		3	1988-1992		X							X																									
Huston, M.A.	Biological Diversity: The Coexistence of Species on Changing Landscapes	1994		3																																			
Kanabis, W.G.	BIFI Propagation Tests of 30 January 1968	1968		3		X																																	
Kutty, M.K.	Estimation of the Age of Exploitation at a Given Fishing Mortality	1968		3																																			

Author(s)	Title	Article Year	Alternative Topics	Relevancy	Data Year	REGION							TYPE OF STUDY								GIS Layers	MPRSA Criteria																	Use for Site Management Plan
						Block Island	Narragansett Bay	Rhode Island Sound	Buzzards Bay	Vineyard Sound	Nantucket Sound	Other	Environmental Analysis	Field Sampling	Lab Analysis/Tests	Model	Monitoring	Baseline Characterization	Impacts Analysis	Historical		40 CFR 228.5 a	40 CFR 228.5 b	40 CFR 228.5 c	40 CFR 228.5 d	40 CFR 228.5 e	40 CFR 228.6 (a) 1	40 CFR 228.6 (a) 2	40 CFR 228.6 (a) 3	40 CFR 228.6 (a) 4	40 CFR 228.6 (a) 5	40 CFR 228.6 (a) 6	40 CFR 228.6 (a) 7	40 CFR 228.6 (a) 8	40 CFR 228.6 (a) 9	40 CFR 228.6 (a) 10	40 CFR 228.6 (a) 11	
MacConnell, W.P.	Remote Sensing 20 years of Change in Massachusetts, 1951/52-1971/72	1975		3														X																				
SAIC	Index of DAMOS Contributions Disposal Area Monitoring System DAMOS	1990		2								X	X	X	X	X	X	X																					
SAIC	Index of SR - Reports Disposal Area Monitoring System DAMOS	1990		2	varies	X		X				X	X	X	X	X	X	X	X																				
Sedgwick, S.//Collins, C.//Olsen, S.	Commercial Fishing Facilities Needs in Rhode Island	1980		3																																		
Sherman, K.//Jaworski, N.//Smayda, T.	Summary of the Symposium on the Northeast U.S. Shelf Ecosystem: Stress, Mitigation, and Sustainability. Held in Narragansett, Rhode Island on August 12-15, 1991	1992		3													X																					